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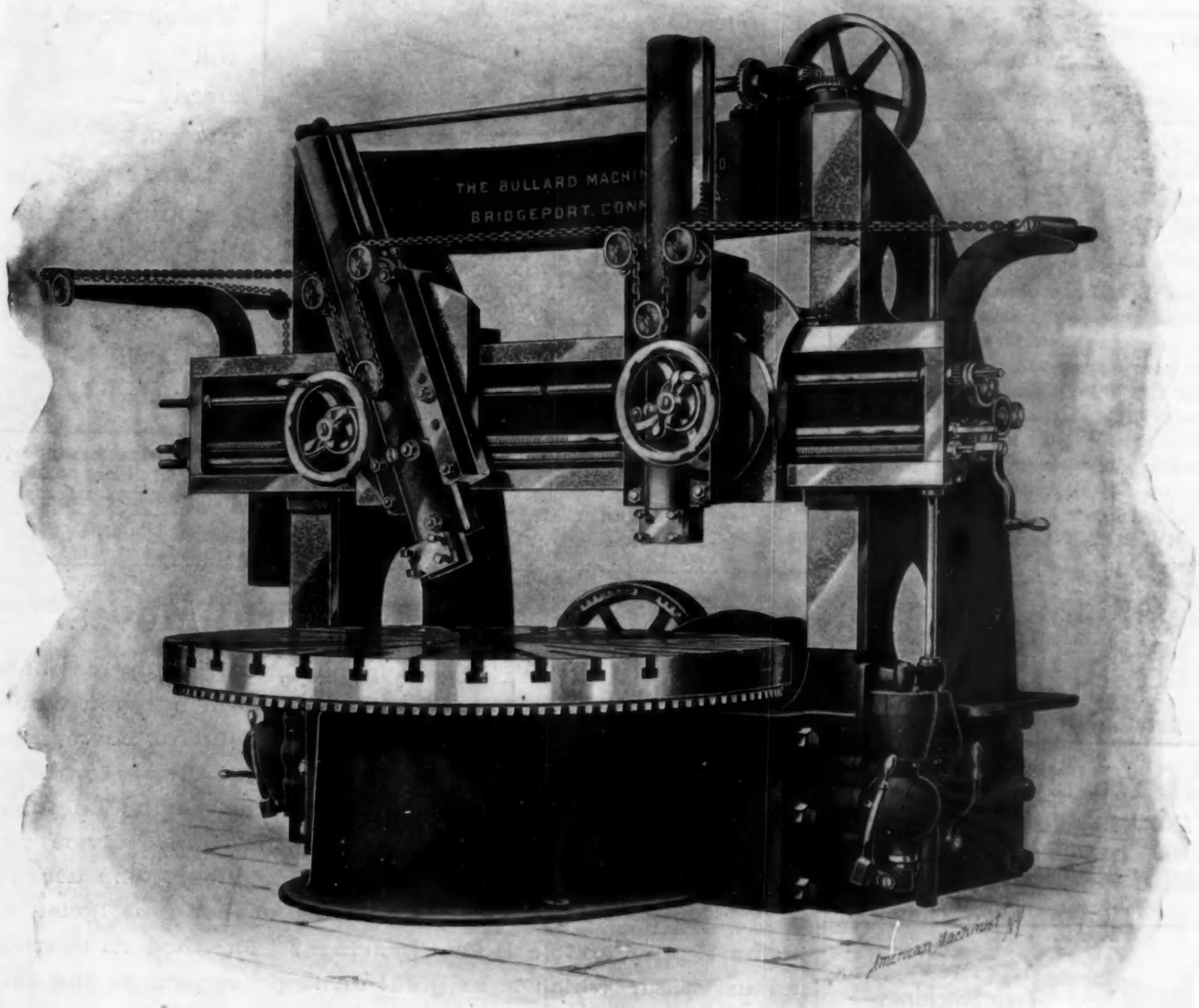

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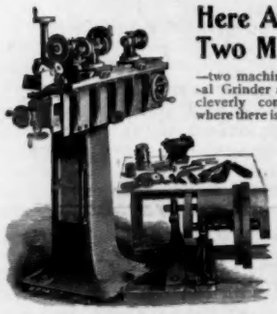

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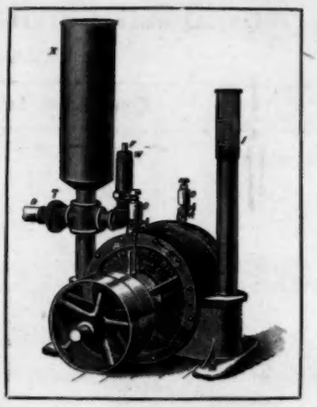

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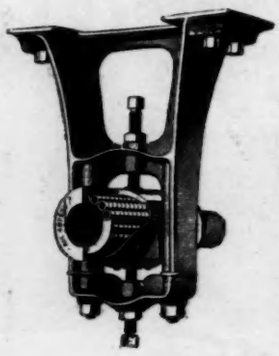

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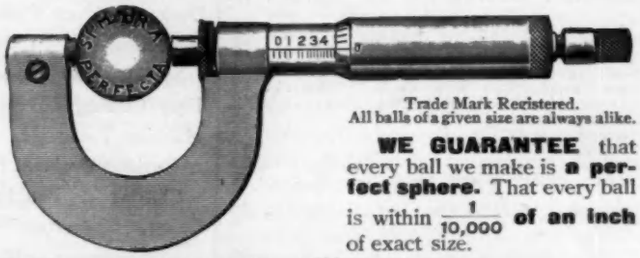

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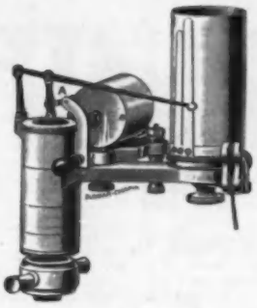

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English Contracts With American Locomotive and Bridge Builders.

Our English cousins are profoundly stirred by the repeated success of our manufacturers not only in neutral markets, but in the English home market as well, and scarcely a week passes without more or less discussion of the subject on the part of our English exchanges. Most of this discussion, we are bound to say, is in an admirable spirit, being conspicuously marked by that spirit of speaking out in meeting which we have before now referred to as characteristic of the English press. Perhaps we are mistaken, and we hope we are, but we very much doubt if, were the circumstances reversed, our own press would show the good nature, the good will or the frank recognition of superiority that in many cases is shown by the English papers.

No one circumstance of this kind has received so much attention as the recent orders for locomotives placed with American builders by the Midland and Great Northern Railways of England. In this connection we observe a recurrence of an error regarding American methods in locomotive building which we have before now pointed out, but the repeated appearance of which justifies further notice on our part.

This error lies in the curious belief that in this country locomotives are manufactured like sewing machines and sold from stock—the builders stocking up in slack times and selling off these accumulations when business revives. Thus in the "Mechanical World," of Manchester, under date of April 14 last, we find the following:

"We believe it is quite correct to say that in both these instances [the Midland and Great Northern orders] the question of speedy delivery determined the placing of the orders with the Baldwin and the Schenectady locomotive works, since the arrears of work due to the dispute in the engineering trades eighteen months ago rendered it impossible for English and Scotch firms to complete the contracts in time. . . . It must be remembered that the locomotives will be of the American, and not of the British type. The fact must also not be overlooked that the Baldwin Company, the Schenectady Works, and the Pullman and the Wagner companies have their own particular design, and when the railway companies buy engines or rolling stock they accept the special types constructed by and made after the designs and patterns of the former. This system enables the builders in slack times to manufacture for stock, well knowing that the goods thus stored will readily find a market on the demand increasing. In this we have a very feasible explanation of early delivery by American firms of a stock class of goods only waiting to be put together and trotted forth as an example of American competition."

Inasmuch as the system of production described above is commonly considered as characteristic of American shops, it is pardonable on the part of our English friends that they should assume the system to be followed in locomotive building, but nothing could be farther from the facts. Twenty years ago the facts were largely as described. At that time each works did have a characteristic design, and the railroads bought of that builder whose design best met their wants or fancy. With the advent of the superintendent of motive power all this was changed. Specifications then began to issue from the purchaser—each road seeking to develop locomotives suited to its traffic and of harmonious design throughout the system. So far has this gone to-day that it is safe to say that practically all American locomotives are built to order, work on every lot put out being begun after the order is given.

These specifications are very voluminous, covering almost every detail of the engine, and it would probably be impossible to find two lots of engines which were duplicates, unless the orders for both lots came from the same road. Of all organized American mechanical industries there is probably less manufacturing connected with locomotive building than any other, unless it be heavy machine tool building, manufacturing being understood as the repeated production of the same article. A fact which speaks to all in this connection, and, moreover, speaks louder than any such statement as the foregoing can, is that at the Baldwin works at the present time a force of 125 draftsmen are employed. Our readers can judge better than we can put in words how far this agrees with the English conception of manufacturing locomotives for stock. There is no possible doubt that work on the locomotives covered by these English orders was begun after the orders were received. To anyone familiar with the conditions of locomotive building in this country any other supposition is absurd.

At the same time we have never been disposed to plume ourselves on the quick delivery of these locomotives, as compared with the time required by English builders, to the extent that many of our contemporaries have done. We have no doubt that the arrears of work in English shops, growing out of the engineers' strike, and the very active state of business in England has had much to do with it. At the same time it is a fact that Englishmen know very little about locomotive building as an organized industry. The system of building their own engines, followed by English roads, has of course operated to prevent the development there of such great locomotive works as those existing here. There is in Great Britain no single locomotive works to be compared with several of our leading shops, and this must be considered a leading factor in what seems to English engineers the phenomenally quick delivery promised on these contracts. Consider for a moment what it means to have the tremendous resources of the Baldwin works, with a capacity exceeding three locomotives per day, turned on such special contracts as these, for the sake of the world-wide comment which the mere taking of the orders was sure to bring forth, and

which in fact it has brought forth. No amount of direct expenditure could have been half as effective as an advertisement as has the taking of these contracts with the quick deliveries promised. In such an immense establishment as the Baldwin works these engines might be given the preference to a degree that would greatly hasten their delivery without seriously affecting other contracts in progress. Of course the existence of such works is a proper source of national pride, and may be said to be the outgrowth of the American system of production, and their achievements may with a certain degree of fairness be credited to American methods, but we do not believe that the record in the present case is due to American methods, as that term is usually understood, to the extent that has been claimed—and no one can doubt that the "American Machinist" believes in the general superiority of American methods.

When it comes to the bridge contract of the Pencoyd Iron Works, the case is entirely different. It is not here so largely a matter of great resources, for, as such works go, the Pencoyd Works is not large. It is, however, one of the most highly organized and perfectly managed establishments of which we have any knowledge. Bridges cannot, of course, be manufactured in the sense that small machines are manufactured; but the American type of pin-connected bridge possesses capabilities in the direction of quick production that English engineers have been slow to recognize. The English riveted bridge must be, to a large degree, built upon its site, instead of, as with the American pin bridge, being built at the bridge works and merely erected on its site. This opens up possibilities in the way of organized and hence quick production at the bridge shop, where the facilities are of the best, which compare most favorably with production by means of the extemporized and make-shift appliances which are necessary with work done in the field. The suspicions to which some English engineers have given expression, that unfair means in the shape of advance information was the real reason for the quick delivery promised by the Pencoyd works in this instance, simply shows how little they appreciate the advantages of the American type of bridge from this point of view. There is probably no industry in which American methods show to better advantage in comparison with those used elsewhere than in that of bridge building.

When European engineers have called upon us in the course of their visits of inspection to this country, and have asked our advice regarding desirable works to see, we have in several cases advised a visit to the Pencoyd works, knowing that in comparison with their own works they would there see not only a highly developed and organized industry, but one based on a fundamentally different system of construction to the one with which they were familiar, and that they would thus see more that to them was novel than in almost any other line of work. Among American engineers, too, we are convinced that, except on the part of those engaged in the industry, there is too little appreciation of the methods used in our bridge works or of the distinctly characteristic line of development which they represent.

Why American Machine Tools Win

"Industries and Iron," of London, speaking of the importation of American machine tools into England, says: "This trade is increasing day by day, since each machine acts as a kind of advertisement for another. Standard patterns and tools that do the most work in the least time, and at the least expense, are mainly accountable for the inroads which have recently been made to the prejudice of the engineering trades of this country." Our esteemed contemporary goes on from this to try to reason out the cause for the superior productive facilities and the higher rates of accomplishment with us. "For this the patent laws of this country are largely accountable," it says; that is, it condemns the English patent system and extols the American, and by implication attributes to our patent laws the efficiency of our tools.

Now, we certainly have no need to speak of our high estimate of our patent laws, or of our appreciation of the great work that they have accomplished for us. But in the present case our perplexed contemporaries should not be so readily satisfied with so simple an explanation. While our patent laws, and our systematic protection of the property rights of inventors, have directly and indirectly stimulated and encouraged us, they still do not furnish the chief element of our success. This is evident from the incontrovertible fact that the essential conditions of high production do not depend upon patented or patentable devices. The highly extolled machines which our neighbors are buying from us in self-defence have usually few patented features, and many of them none at all. There is no patent upon speeds or feeds; there is no patent upon multiplicity of cutting tools; there is no patent upon the avoidance of lost time in machine operations, nor in securely holding or strongly driving work, or precisely adjusting the tool to the work or the work to the tool. There is no patent upon any automatic device simply for its automaticity. There is no patent upon a workman which impels him to get what he can out of a tool to-day and more to-morrow, and enables him to see the opening opportunities for still further improving each existing machine. There is no patent compelling us to continually supersede our best tools by others still better, as there has been no English patent which has compelled the retention of ancient tools and antiquated methods.

What is needed most of all is the American shop atmosphere, and this it will be found not easy to import. In our shops the air is such that anomalous and antagonistic conditions do not flourish. If the manufacturer sees on the one hand the necessity of cheapening or increasing production to enable him to hold the market, the workman in his shop does not hold to the theory that there is only so much work in the world, and that if any man does too much some other man must go without employment. While we are cheapening production we are making work all around. Our tools are continually improved, not by a few inventive geniuses, but by the active instinct of conquering industry. English workmen as well as English manufacturers should welcome American tools whenever and because they show themselves superior, and until they have this all-around welcome they will not be able to do their best.

Mechanics' Living in England.

Regarding the relative cost of living in this country and England, we are often asked for information, and a great many misunderstandings arise because this is a matter which is viewed from different standpoints by different individuals.

The British employer, for instance, knows that his men live more cheaply than men live here, and he is entirely conscientious in saying that living is cheaper over there than here; but the fact is that it is a different kind of living, and that when the American goes over to Great Britain and undertakes to live there as he has been in the habit of living at home, he finds his expenses usually greater and never less than here. Considerable disappointment and dissatisfaction have resulted from this, and a curious fact about it is that among the first men to become discouraged with their experience in Great Britain and to return to America are Englishmen who have been born and raised there, but who come over here, work for a time, and then imagine they would like to try it at home again for a while. They soon find that things do not appear to them as they did while living there previously, and become dissatisfied more quickly, it is said, than Americans do.

Some trade combinations having new features have, it seems, been formed in England, and particularly in Birmingham, where we learn that the manufacturers of brass bedsteads, for instance, have formed an organization in which the workmen's union is included, wages being paid upon a sliding scale depending upon prices and profits. So thoroughly are the interests of employer and employees united in this way that on a recent occasion when a factory undertook to draw out from the organization, all its employees struck and

refused to work until it was reinstated in its membership. Whatever may be said for or against combinations, there can be no doubt whatever that this plan greatly strengthens them, and we may expect that the example of the Manchester employers will be followed elsewhere.

Commercial Review.

NEW YORK, SATURDAY EVENING,
April 29, 1899.

ENGINES AND BOILERS.

The business depression of the last five or six years has in one way been productive of benefit. It has taught manufacturers lessons of economy. In the days of small profits, or of no profits at all, users of power had their eyes opened to the imperfections of their plants, which were constant sources of waste, and they formed plans for improvements which they intended to bring about when they could afford the outlay. The time has arrived when they can afford it. They are now putting in modern and economical steam generators, centralizing the boiler rooms of their plants where these have hitherto been divided and scattered among different buildings, and in other ways availing themselves of the present exceptionally favorable opportunity for reform in methods and machinery.

That nervous activity among engine and boiler manufacturers which has marked this year hitherto continues to an intense degree. "The number of boilers which we know to have been sold within the last two months is simply extraordinary," says a representative of a prominent engineering and contracting firm. "From our personal knowledge of the work that is being estimated upon we are confident that the present degree of activity among steam plant manufacturers will continue for six months or a year at least."

Long deliveries and strong prices still characterize both engines and boilers. Advances in engines continue to be reported here and there, and the higher prices asked are becoming more nearly universal. Certain manufacturers claim that the increases on some of their large engines amount to 50 per cent., but this is exceptional. In the past six weeks an engineering firm in this city has had occasion to call for bids on over $100,000 worth of engines of 500 horse-power or over, and in all cases were quoted prices ranging from 10 to 20 per cent. above those prevailing at the lowest. Four companies which were cited to us required from five months upward for delivery. Indeed, there are certain concerns which in ordinary large engines are sold out for the year. Representatives of some engine manufacturers complain that they are able to take but few orders because of the difficulty in filling them. A company in Michigan which is anxious to install three 600 horse-power engines has found it necessary to arrange for a temporary plant, using as much power as they can obtain from plants now in operation.

Boiler manufacturers quite generally require three months for delivery where plates are not in stock. But it transpires that not a few of them have been carrying over fairly heavy stocks from the days of lower prices, and are able to make earlier shipments. Some of the parties who bought material when it was cheaper are causing annoyance to their competitors by taking orders at low rates. Boiler makers who have to wait upon the plate mills have great difficulty in obtaining promises of delivery, and so are hindered in naming definite shipments to their customers. It is said that several small shops have had to shut down because of the lack of material. This stringency is greater in plates than in tubes; hence it appears to bear harder upon fire-tube than upon sectional boiler manufacturers.

The following extract from a letter written by an engine and fire-tube boiler company shows the embarrassment for requisite materials that exists in some quarters: "In our business experience we have never encountered anything more annoying than the delay which is occurring in procuring boiler plate. This condition began in January and has been developing increased inconvenience ever since, and we, with all other boiler manufacturers, are working with decreased output on this account, and while we have a very considerable number of boilers of some styles and sizes, and as well some full plates, we have not any material that would be suitable to construct this boiler."

An old-established company which manufactures both plain slide-valve and automatic engines notice a relative increase in demand for the latter, which indicates that engine users are more generally availing themselves of electricity in their plants.

The United Railways and Electric Company, Baltimore, Md., has ordered of McIntosh, Seymour & Co. three 3,000 horse-power vertical cross-compou d condensing engines, to be direct connected to 1,800-kilowatt General Electric alternators, for railway and other electric purposes.

The Heine Safety Boiler Company, St. Louis, has sold to the Baldwin Locomotive Works, Philadelphia, 3,000 horse-power of boilers to replace other water-tube boilers there in use. About the middle of May 2,600 horse-power of Heine boilers will be shipped to South Africa for use by various parties for mining and other purposes.

The Aultman & Taylor Company, Mansfield, Ohio, manufacturers of the Cahall and Thayer boilers, are running their works twenty-four hours a day, with three shifts of men.

Among the New York engine and boiler trade the present disposition is to occupy well-appointed offices in modern buildings, and carry no machinery locally in stock, rather than to have their goods spread out in a store. The Ames Iron Works, which are one of the few companies which have hitherto kept engines on exhibition, will discontinue the ware-room feature and will move May 1 from the store at 38 Cortlandt street to offices in the Singer Building, Broadway and Liberty street.

MISCELLANEOUS.

Great activity prevails in water-wheel manufacture.

Some important hydraulic and electric power distribution is contemplated in the South. One plant is projected which will involve $3,000,000 outlay, and another which will cost about half that sum, both of them being figured upon by the same engineering firm. The currents will be used for miscellaneous purposes, including the operation of cotton mills. We hope to have more to say about these installations when plans materialize.

Pneumatic tools have become popular in the Central Western States and are finding extensive employment in machine shops.

An old-established machinery dealer who makes a specialty of wood-working machinery explains the conditions which are making for the deterioration of that line in New York City. In a period of eighteen months, lately ended, seventy-five or more wood-working shops in Greater New York had to go out of business, and the industry locally seems to be on the high road to total extinction. One cause our informant finds in trades unions, which exact high prices for labor, allowing their men to work only eight hours a day here, though ten hours' work is common in Western towns. The wooden trimmings of New York buildings, it is stated, can in some cases be put in 20 per cent. cheaper by outsiders than by local firms. Another fact which militates against wood working, and other manufacturing industries as well, in this city, is the stringent factory restrictions; for instance, the prejudice against the use of soft coal, which was a matter slated to be brought before a late grand jury.

CHICAGO MACHINERY MARKET.

Inquiries for electrical power are numerous from both small and large manufacturing shops. Among others is that of the Chicago & Northwestern Railroad Company, which is asking bids for the complete equipment of its Forty-eighth street shops in this city. The company has recently been adding some buildings to the shops and now proposes to supply the plant with a 500-kilowatt generator and numerous motors. One line of shafting to be displaced is said to be 900 feet in length. Another large Western railway system has under advisement the equipment of its shops with electrical power.

Some sellers of electrical motive power report that April business has been less active than that of March. This state of

trade is not general, and the aggregate is large. Bids are asked for the equipment of the Hammond packing plant at Kansas City, and other similar establishments are said to be preparing for the same change in power. There is considerable activity this spring in the development of inter-urban electric lines, among which may be mentioned several links along the North Shore from Chicago, and one road to Lake Geneva, Wis. Protracted delay is reported in obtaining material of all kinds, and early deliveries of rails are practically impossible. Some builders of electrical machinery are in a position to make early shipments, but among the better class orders are crowding more or less, and new business must get in line and take its turn.

The Siemens & Halske Company has sold to the Cleveland & Eastern and to the Cleveland & Chagrin Falls Street Railway companies each a 500-kilowatt generator. Siemens & Halske Company last week purchased machinery to the value of $11,000, consisting of lathes, drills, grinders, milling machines, slotters, etc., from the Brown & Sharpe Manufacturing Company, the E. W. Bliss Company, and other builders.

The Crocker-Wheeler Company is now equipping the Latrobe Steel & Coupler Company plant near this city with a 200-kilowatt generator and with motors to operate about one-third of the plant.

There is perhaps no branch of the metal machinery market that is more active than mining. Manufacturers are receiving orders from all parts of the world and are unable to keep up with the demand. Thus the Gates Iron Works is running twenty-four hours a day, in two shifts of twelve hours each, but is six months behind its orders.

For all kinds of transmission of power machinery the demand is satisfactory to most interests concerned. All kinds of plants are doing something in this line, either by way of repairs and changes or additions. The new Van Ingen Building, corner Canal and Jackson streets, has been fitted up with rope transmission and its eight floors equipped with friction clutches by the Hill Clutch Company.

Among recent orders of the Chicago Belting Company is one for a 72-inch three-ply belt, 163 feet in length, for a local manufactory.

INTERNATIONAL POWER COMPANY INTERESTS.

Among recent orders received by the International Power Company interests are the following for Greene-Wheelock engines: Columbus (Ohio) Street Railway, 1,200 horse-power engine; Oakland (Cal.) Paper Company, 500 horse-power; Bibb Manufacturing Company, cotton goods, Macon, Ga., 1,000 horse-power, the second order thence received; Long Island Railroad Company, three 700 horse-power engines for an electric road, third rail system; for the Alpha Cement Company, 800 horse-power, cross-compound, just shipped; Chicago Portland Cement Company, 800 horse-power, cross-compound, just started up. The following Corliss engines are among late sales: Woonsocket (R. I) Rubber Company, 1,200 horse-power; Tremont and Suffolk Mills, Lowell, Mass., 1,200 horse-power, cross-compound. The Wabash Railroad has ordered twenty-eight locomotives from the Rhode Island Locomotive Works.

The following statement is furnished us by a prominent official of the International Power Company:

"The entire works of the Corliss Steam Engine Company, Providence, R. I., have been transferred to Alfred H. Hoadley, general manager of the International Power Company, and the works are now operating under lease to the International Power Company, it being understood that this is a preliminary step to the International Power Company's absorbing the entire property and business of the Corliss Company."

CINCINNATI REPORT.

The encouraging condition of trade in all lines of machinery and machine tools, as noted in previous letters, still continues in increasing p oportions. The business of March showed a gain over that of February. There has not been a time in some years when even woodworking machinery manufacturers have been so busy. Those of engines, machine tools, electrical and other kinds of machinery have enough orders to keep them occupied for periods of time ranging anywhere from three and six months up to one year. Buyers have trouble in securing satisfactory delivery, though manufacturers are making every effort to meet the needs of customers, including more or less night work. Many factories have enough home trade to keep them fully busy, letting alone export trade. Foreign business is of greater volume as the weeks pass by, and largely in excess of what was being done at the same time a year ago, and prospects are very favorable for its keeping up for the rest of the year. Foundrymen are quite busy filling orders for castings, but are not getting the advance in prices which the increased cost in material and labor should give them, ranging from ten to tnirty cents per hundred weight. Neither have manufacturers generally made advances in proportion to the rise in cost of material and labor.

The G. A. Gray Company is now working in its new plant, some 50 feet front by 300 feet deep. While their business is exceedingly active in home and foreign trade and they have 150 men working on full time, they do not think it wise to increase their present force to secure a larger output, and perhaps overdo the matter. The Rahn & Mayer Company has the foundations of its new buildings on Spring Grove avenue about completed. They continue very busy, having large orders from Germany and Russia, and one from Italy, and some good orders from Chicago and Pittsburgh. They are working thirty-five men and running part of the force on night work. The J. A. Fay & Egan Company continues making improvements in its plant, having already put in $50,000 worth of the latest improved machine tools and is erecting an addition some 60x100 feet. If business continues to increase as it has in the past few months they will have to work at night. The Bradford Mill Company is rejoicing in the growth of business. It is having enough home orders to keep its men steadily employed on full time, and foreign ones are still coming in. It has now a force of 135 men, and may increase the number to 150. The Bickford Drill & Tool Company finds business increasing all the time; present orders will keep it fully occupied for several months to come. It has put in considerable new machinery, including a 56-inch x 62-inch x 16-foot spur-gear two-head planer, and has expended in all about $10,000 in improvements. It has on hand one large home order for $50,000 worth of goods.

Quotations.

NEW YORK, Monday, May 1.

Iron—American pig, tidewater delivery:—

Pennsylvania irons:	
No. 1 X foundry	$16 75 @ 17 00
No. 2 X foundry	15 75 @ 16 00
No. 2 plain	15 25 @ 15 50
Gray forge	14 75 @ 15 00
Alabama irons:	
No. 1 foundry	16 00 @ 16 50
No. 2 foundry	15 25 @ 15 75
No. 3 foundry	14 75 @ 15 25
No. 1 soft	16 00 @ 16 50
No. 2 soft	15 25 @ 15 75
Foundry forge	14 25 @ 14 75

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.50 @ 1.55c., nominally; refined, 1.58c., upward. Store prices: Common, 1.70 @ 1.75c.; refined, 1.75c., upward.

Tool Steel — Base Sizes — Standard quality, 6 @ 7c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 2.00 @ 2.05c.

Cold Rolled Steel Shafting—Base Sizes, from store, in small lots, 3.00c.

Copper—Carload lots, Lake Superior ingot, 18½ @ 19¼c.; electrolytic, 17½ @ 18c.; casting copper, 17 @ 17½c.

Pig Lead—Carload lots, 4.32½ @ 4.37½c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 26¼c., f. o. b. New York.

Spelter—In carload lots, 6¾ @ 7c., New York delivery.

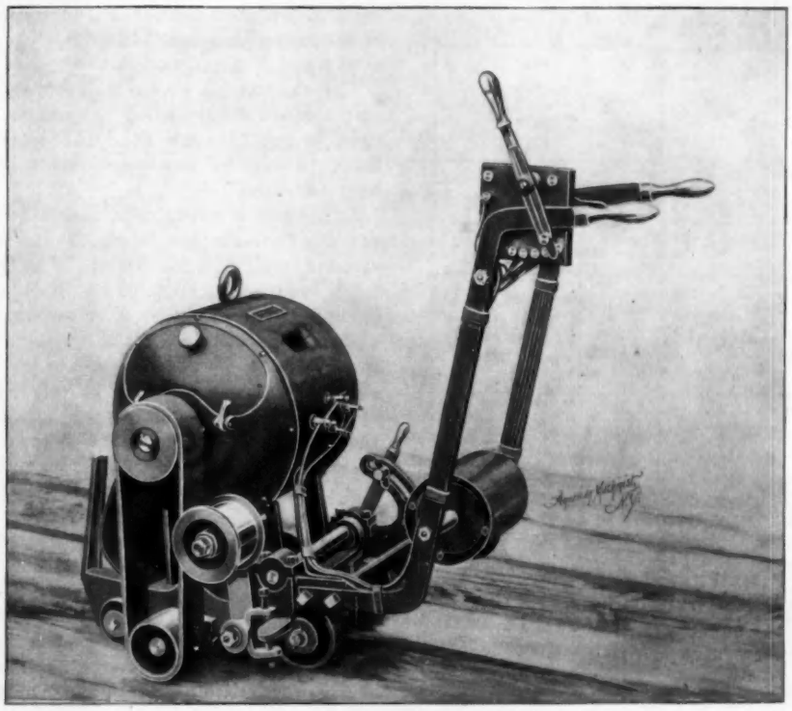
Antimony—In cask lots and over, 10 @ 11c., according to brand and quality.

Lard Oil—Prime City, present make, 44 @ 46c., wholesale. On an especially large quantity 43c. might be accepted.

Deck and Floor Planing Machine.

The accompanying half-tone illustrates a genuine novelty. Few of our readers we fancy would guess the purpose of the machine from this or any other picture of it.

It might be described as an exaggerated lawn mower, with the further explanation that it mows wood instead of grass. It is, in fact, an electrically-driven planing machine for the floors of buildings or the decks of ships. With this explanation the main features of the machine will be clear from the illustration. A motor above drives the cylinder below, and the wheeled frame and handles furnish the means for manipulating the machine. The



DECK AND FLOOR PLANING MACHINE.

drum between the handle bars contains the starting box, while the starting switch and main line switch are placed where convenient to the operator—the latter being so placed that it may be quickly opened if desired with the thumb of the left hand, and without letting go of the handle.

The adjustment for depth of cut is through an eccentric shaft and adjusting lever plainly seen. This shaft operates through a radius piece, which carries the rollers. This radius piece is free to swing through a limited range, and is so adjusted that whenever the operator pulls the machine toward himself it will swing to the upright position and so raise the machine sufficiently to make the knives clear the floor being planed, while pushing the machine in the opposite direction acts in the contrary way to cause the knives to take hold. To further facilitate the working of the machine the wheels are fitted with roller bearings. To enable the planing to be done close up to a wall, a supplementary outside cylinder is provided, and to prevent damage this is provided with a guard.

The machine is the recent product of Thomas H. Dallett & Co., of York street and Sedgley avenue, Philadelphia.

Deflection of Cylindrical Helical Springs.

BY ROBERT A. BRUCE.

In an article upon the strength of cylindrical helical springs, the writer demonstrated that under an axial load the principal stresses on the material are shearing stresses, every section being subject to a twisting couple, the arm of which is the distance of the center of section from the center line or axis of the helix, and the force of which is the axial load. The condition that other forces might be neglected was shown to be that the coils are, comparatively speaking, flat. In the springs used in ordinary engineering practice this condition is sufficiently fulfilled to justify other forces being neglected and attention being bestowed upon the twisting forces only. A spring is made strong enough to resist the greatest axial load by making tne section of sufficient magnitude to endure the twisting couple without allowing the most stressed portion of the section to encounter a stress greater than some limited amount fixed by experiment or previous knowledge of the material. It still remains, however, to show how to so proportion the spring that it shall have the proper amount of yield or deflection. The deflection—that is, the amount the spring elongates or contracts in its length—is directly proportional to the load. Hence we only require to know the deflection for one particular load; the maximum deflection which the spring can safely endure being that corresponding to the maximum safe load.

If a wire of the same section and length as those of a spring be clamped at one end and subjected at the other to a twisting load equal to that placed on the spring, and at a radial distance equal to the helical radius of the spring, it can be shown, both mathematically and experimentally, that the linear displacement of the load on the wire is equal to the extension or contraction of the spring. The experimental demonstration of this fact is as follows:

Two pieces of wire are chosen of the same section and material (such as two pieces of steel wire from the same hank). One of these is twisted into a helical spring and loaded so that its deflection V can be observed under a given load W. The other is (see Fig. 1) fixed firmly at one end A in such a manner that it is prevented from rotation. To the other end B is fitted a bearing allowing it to freely rotate. On to its projecting end is fixed a disk C with a groove in it, and a cord is placed around the groove, the dimensions being so chosen that the distance from the center of the cord to the center of the wire is made equal to the radius of the coiled

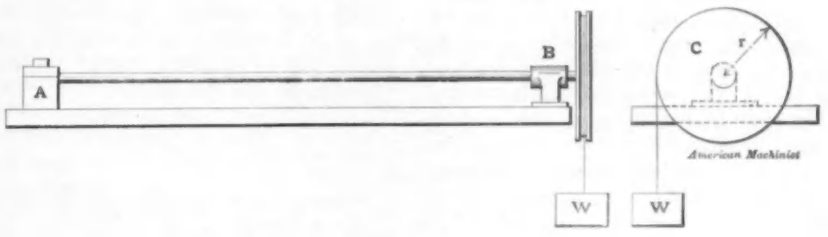


Fig. 1

EXPERIMENT TO ILLUSTRATE DEFLECTION OF HELICAL SPRINGS.

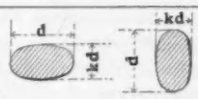
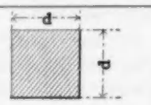
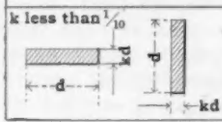
spring, and that the length of wire which can be twisted by hanging a weight on the cord, is equal in length to the part of the other wire in the spring, which is subject to a twisting moment. On hanging a weight on the cord equal to that used to deflect the spring, it will be found that the distance the weight descends is equal to the deflection of the spring under the same weight. [This experiment may be

SYMBOLS USED

N = Modulus of Rigidity A = Torsional Rigidity
D = Helical Dia. of Spring n = Number of Effective Coils
W_1 = Axial Load Deflecting Spring by one Inch
V = Deflection of Spring in Inches under Axial Load W
ϕ^0 = Angle of Torsion of Bar of Length l Subject to a Uniform Twisting Moment T Inch Lbs.
V_s = Maximum Safe Deflection when f_s = Safe Shearing Stress

FORMULAE USED

1. $A = M \times N$ (Where $M = Bd^4$)
2. $\phi^0 = \frac{180}{\pi}\frac{Tl}{A} = C \times \frac{Tl}{Nd^4}$ (Where $C = \frac{180}{\pi B}$)
3. $W_1 = \frac{4}{\pi}\frac{A}{nD^3} = \frac{4}{\pi}B \times \frac{Nd^4}{nD^3}$ (Where $\frac{4}{\pi}B = F$)
4. $V = \frac{\pi}{4}\frac{WnD^3}{A} = S \times \frac{WnD^3}{Nd^4}$ (Where $S = \frac{1}{F} = \frac{\pi}{4B}$)
5. $V_s = U \times \frac{nD^2 f_s}{Nd}$ Where U is given in Column 5

FORM & DIMENSIONS OF SECTION	NUMERICAL VALUES OF CONSTANTS				
	1 B	2 C	3 F	4 S	5 U
	.098174	583.61	.125	8	3.14159
	$\frac{.196348}{(1+k^2)}$	$291.8(1+k^2)$	$\frac{.25}{(1+k^2)}$	$4(1+k^2)$	$\frac{1.5708}{k^2(1+k^2)}$
	$.098174 \times (1-k^4)$	$\frac{583.61}{(1-k^4)}$	$.125(1-k^4)$	$\frac{8}{(1-k^4)}$	3.14159
	.14058	407.56	.17899	5.586	2.3263
k less than 1/10 	USE THESE VALUES ONLY WHEN k IS LESS THAN .1				
	$.3333\frac{k^3}{k^2+1}$	$171.88\frac{k^2+1}{k^3}$	$.42441\frac{k^3}{k^2+1}$	$2.3562\frac{k^2+1}{k^3}$	$\frac{1.5708}{k}$

American Machinist

TABLE I. DEFLECTION OF HELICAL SPRINGS AND ANGLE OF TORSION OF TWISTED BARS.

made to show the performance of a proposed spring before it is made, or the dimensions of a spring necessary to meet given requirements. It is useful, also, to know that in the case of steel springs which are to be hardened after coiling, the experiment is still applicable for loads which do not overstrain the soft material. The effect of hardening on steel is to increase the load which it can carry without set, but not to change its behavior under small loads.—Ed.]

If the whole length of the spring be considered, and the helix is supposed to consist of a complete number of coils, then it can be shown that there is no twisting of the wire as a whole, i. e., lines originally vertical remain vertical. It is important to note this fact, that as regards rotation about the center of section there is no rotation of one end of the wire relative to the other end, unless the number of the coils is fractional; in any case it is slight, but it is as well that in all cases where it is advisable to avoid tilting or springing aside of the ends of a spring that the condition should be observed. The writer has not seen the point referred to, and its existence is unknown to most spring makers.

The stress on the wire of a helical spring being torsional, the formula for the angle of torsion for an applied load may be applied to such a spring. Suitably transformed the formula is

$$V = \frac{\pi}{4}\frac{W n D^3}{M N} \qquad (1)$$

in which

V = extension or compression of spring in inches.
W = load in pounds.
n = number of coils in spring.
D = diameter of helix in inches.
M = modulus of the section.
N = modulus of the material.

For a circular bar of diameter d, $M = \frac{\pi d^4}{32} = .098174\ d^4$, and for a square bar having a side d, $M = .14058\ d^4$. For any regular section M varies as d^4 where d is the greatest dimension, or we may write $M = Bd^4$. Values of B are given in Table I.

The modulus of rigidity N depends on the material. Its value for various materials is given in Table II.

From the values of N given in Table II and the values of M obtained from Table I, the reader is now in a position to calculate the deflection of any cylindrical helical spring under any load.

Suppose $V = 1$. Then from (1)

$$1 = \frac{\pi}{4}\frac{W_1 n D^3}{M N} \text{ or}$$

$$W_1 = \frac{4}{\pi}\frac{M N}{n D^3} \qquad (2)$$

W_1 being the force necessary to extend or shorten the spring by 1 inch. By putting W equal to the greatest safe-load on the spring in (1) it is easy to obtain the greatest safe deflection. Table III will greatly facilitate calculations of W_1 by the use of the tabular numbers and the formula at the top. This table assumes $D = 1$, $n = 1$ and $N = 11{,}500{,}000$.

The expressions given in Table I are very useful for calculating the amount of twist in any bar, and nearly all sections liable to receive twisting stresses have been tabulated.

Turning our attention to Table I, the various formulæ are tabulated and the variable coefficients for sections of various forms are given in columns 1 to 5. It will be noticed that column 2 is not immediately connected with the question of springs, but by its use the angle of torsion of a bar of any section may be very readily calculated—a matter of some importance in design in connection with stiffness, though it should here be remarked that the practice of designing shafts from this consideration alone should never be permitted. (The reader can see into what sort of errors he is led by calculating the diameter of a shaft so as not to deflect more than 1 degree per 10 feet of length for a twisting moment of 100,000 inch-pounds, and again for 100 inch-pounds, and then calculating the value of f in each case.)

MATERIAL.	N. in Inches and Pounds.	Authority.
Steel Plates (.25—1.00 %c)	13,000,000	Perry.
Swedish Spring Steel (Hardened).	12,540,000	Young (Proc. Inst. C. E., Vol. CI.)
Swedish Spring Steel (Unhardened).	11,650,000	Young (Proc. Inst. C. E., Vol CI.)
Soft Steel	11,650,000	Cotterill.
Hard Steel	11,650,000	"
Mild Steel (Unhardened).	11,000,000	Perry.
" " (Hardened)	11,000,000	"
Wrought Iron	11,200,000	"
" " (Bars)	10,500,000	"
Delta Metal	5,250,000	"
Brass	5,000,000	"
Phosphor Bronze	5,200,000	"
Gun Metal	3,700,000	"

TABLE II.—VALUES OF N MODULUS OF RIGIDITY.

Table III has been compiled for the purpose of enabling a quick calculation of the load to deflect a steel spring one inch being performed. In columns 2 and 6 (used for round sections) values of tabular numbers are given for values of d from 1-16 to 1 inch, and for $N = 11{,}500{,}000$, which is the average value selected for good spring steel. By dividing the num-

ber opposite d by the product of the number of coils and the cube of the helical diameter (found from Table IV) the quotient found gives the force in pounds which will extend or compress the spring by one inch. The numbers in columns 3 and 7 are used in a similar way for springs of square section. Values of d^4 have been added for convenience in columns 4 and 8. Given any three of the four factors, W_1, D, d, and n, it is obvious that the fourth can be found by the use of this table. For example, suppose W_1 (axial load to alter length of spring by 1 inch) = 50, d = 11-32 inch and D = 4 inches, and that the section is square. Then we see that the number in column 3 opposite 11-32 is 28,741; hence

$$\frac{28{,}741}{D^3\ n} = 50, \text{ or}$$

$$n = \frac{28{,}741}{50 \times D^3}$$

since $D^3 = 4^3 = 64$

$$n = \frac{28{,}741}{50 \times 64}$$

$$= 9 \text{ very nearly.}$$

Table IV assists these calculations by giving the value of D^3 for values of D from 1 inch to 8 inches, advancing by eighths. Table II gives some values of N, which have been found by experiment. As, however, materials are constantly being improved, the reader must from time to time supplement the values there given as fresh information about the new material comes to hand. It may be remarked, however, that the writer has found by experiment that in the case of such materials as bronze, a wide difference in composition and a variation of ultimate tensile strength of as much as 100 per cent. may exist and yet the value for N may not vary more than 10 per cent.

(Concluded next week.)

Pipe Cutting Machine.

The accompanying half-tone shows a new pipe cutting machine which has just been brought out by the Fox Machine Company, of Grand Rapids, Mich. The machine is constructed on the lines of the bicycle tube cutting machine by the same makers, which was illustrated in our columns recently.

The general construction will be plain from the illustration. The hand wheel at the right adjusts the lower or bearing rolls for the size of pipe to be cut, while the hand lever applies the pressure for the actual cutting. The bearing rolls below are of hardened steel, and the pressure on the cutter shaft is received by a similar pair of hardened rolls, which bear on a hardened sleeve on the driving shaft. A stop gage for length enables duplicate pieces to be cut without loss of time in determining the length.

The capacity of the machine is such as to take pipe up to 2½ inches diameter, which size is stated to be cut in thirty seconds.

W_1 = Axial load deflecting spring 1 inch.
n = Number of effective coils.
TR = Tabular number for round section.
D = Helical diam. of spring.
TS = Tabular number for square section.
d = Diam. or side of section.

$$W_1 = \frac{\text{Tabular number}}{D^3 \times n} \quad \text{or} \quad W_1 \times D^3 \times n = \text{Tabular number.}$$

N has been given the average value 11,500,000.

Side or Diameter d.	TR.	TS.	d^4	Side or Diameter d.	TR.	TS.	d^4
1-16	21.934	31.408	.00001525	15-32	69402.16	99379.0	.04827
5-64	53.551	76.681	.00003725	½	89843.74	128650.0	.0625
3-32	110.43	159.007	.00007724	17-32	114499.44	163956.0	.07965
7-64	205.721	294.580	.0001431	9-16	143912.26	206073.0	.100112
⅛	350.952	502.549	.0002441	19-32	178657.90	255827.0	.12428
9-64	562.157	804.973	.0003910	⅝	219345.05	314088.0	.15258
5-32	856.816	1226.90	.0005954	21-32	266615.24	381776.0	.18547
11-64	1254.46	1796.13	.0008726	11-16	321143.07	459856.0	.22340
3-16	1776.69	2544.11	.001235	23-32	383635.62	549342.0	.26687
13-64	2447.15	3504.16	.001702	¾	454833.0	651293.0	.31640
7-32	3291.54	4713.28	.002289	25-32	535510.0	766816.0	.37252
15-64	4337.63	6211.21	.003017	13-16	626471.0	897066.0	.43580
¼	5615.23	8040.65	.003906	27-32	728556.0	1043245.0	.50682
9-32	8994.52	12879.0	.0062570	⅞	842635.0	1206600.0	.58618
5-16	13709.06	19630.0	.009536	29-32	969616.0	1388428.0	.67451
11-32	20071.45	28741.0	.01396	15-16	1110434.0	1590071.0	.77247
⅜	28427.10	40706.0	.01977	31-32	1266063.0	1812918.0	.88073
13-32	39154.48	56067.0	.02723	1	1437500.0	2058408.0	1.0000
7-16	52664.74	75412.0	.03663				

TABLE III.—CONSTANTS TO BE USED IN CALCULATING THE DEFLECTION OF STEEL CYLINDRICAL SPIRAL SPRINGS OF ROUND AND SQUARE SECTION.

Inch.	0	⅛ Inch.	¼ Inch.	⅜ Inch.	½ Inch.	⅝ Inch.	¾ Inch.	⅞ Inch.
1	1	1.42382	1.95312	2.59961	3.37500	4.29102	5.35937	6.59180
2	8.0	9.59570	11.39062	13.3964	15.625	18.0879	20.7968	23.7637
3	27.00	30.5176	34.3281	38.4434	42.875	47.6347	52.7343	58.1856
4	64.00	70.1895	76.7656	83.7402	91.125	98.9316	107.1718	115.857
5	125.0	134.611	144.703	155.287	166.375	177.798	190.109	202.779
6	216.0	229.783	244.140	259.084	274.625	290.775	307.546	324.951
7	343.0	361.705	381.078	401.131	421.875	443.322	465.484	488.373
8	512.0							

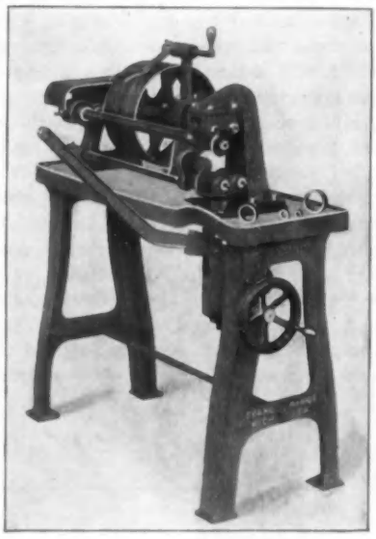
TABLE IV.—VALUES OF D^3.

Machine Tools—II.

BY J. RICHARDS.

SOME HISTORY.

It is not probable that a history of machine tool making will ever be written or published, at least not in an accurate and impartial way. The rise and progress of the art does not, as in most others of the kind, rest upon some generic discovery by a particular person, or in a particular country. Its evolution is as wide as industrial civilization, and, as has been already explained, it goes on independently, and mostly without those scientific aids that invite comparison and tend to standard, or uniform practice; besides, the expense and time required to collect and collate the facts over such a wide field are not warranted. There would be no direct advantage to makers of machine tools, and curiosity would be the only incentive on which the sale of such a work would have to depend.



PIPE CUTTING MACHINE.

These conclusions are twenty-five years old, arrived at by consulting an experienced publisher and after more than a month of diligent work of a preliminary kind to ascertain leading facts. The notes then taken have been scattered and lost, and if at hand, even the most compendious treatment would not bring the subject within the limits of these articles. One thing, however, may be mentioned in respect to these notes, that in nearly all countries where the iron industries are carried on there is an opinion that metal working implements were invented by their own people.

Smiles' "Industrial Biography," published in 1876, and the only work in our language that deals with the history of machine tools, is confined to a few early makers in Great Britain; so limited by the character of the work, it is true, but omitting as I believe, one of the most important, perhaps the most important, of all among the early inventors and im-

provers of machine tools, John G. Bodmer.

As, however, the present paper will seem incomplete without some mention at least of early practice, it is proposed to present some of the most advanced implements of fifty years ago by an account and illustrations of the work of this celebrated Swiss engineer, whose portrait appears on this page.

Mr. Bodmer was not a machine tool maker in the sense of having been directly engaged in that business. The implements, designed and made by him at Manchester, England, were for his own works, or mainly so, were the subject of patents taken out there, and reflect very fairly the most advanced practice of his time—1838 to 1841. He went to England for a second time in 1843 and remained there until 1848, engaged in diversified practice as a constructing engineer. He was a member of the Institution of Civil Engineers, and his death in 1864 called out from that body a memoir of 35 pages, which will indicate his high standing and the importance of his works.

His special field was textile machinery, but his inventions include breech-loading rifled guns, explosive shells, power-driven elevators for buildings, traveling cranes, moving fire grates, double-piston balanced engines, ball and socket bearings, tire or hoop rolling, the Meyer cut-off valves, diametral pitch for tooth gearing, and standard gages, with many other things of note that have passed into common practice. His static work includes a bridge over the Rhine at Geneva and various other structures. His work was divided between Switzerland, England, the Duchy of Baden, and Austria.

I can remember that while compiling the notes before mentioned at the library of the British Patent Office in 1873, after coming down through early European references in Holland, France, and England to Bodmer's improvements in machine tools, the conclusion was that "here is the beginning of practice that has endured," the first clear and logical conception of directing cutting edges and supporting material.

John George Bodmer

It was much the same achievement in metal working as Sir Samuel Bentham's improvements had been in wood converting machines forty years before, and brings to mind Lord Byron's remark that "the thieving ancients have stolen most of our modern ideas." This conclusion, it is believed, will find some warrant in the implements made by Bodmer fifty years ago.

It is proposed, as we go along, to comment briefly upon some of Bodmer's machines, but it will be proper to note at the beginning that the importance attached to certain implements in his time is to be judged by a different standard now. Modern practice, requirements, and methods vary widely from those of 1840. For example: Screw stocks and dies, or "hand screwing tackle," as the English call them, had then an important place, and even in Whitworth's time were considered worthy of the most careful attention and formed an important branch of his work. At this day these things are mostly relegated to country blacksmith shops, and have passed out of the machine shops, or nearly so.

It is proposed to go on, without any plan of classification or sequence, to give illustrations of some of Bodmer's machine tools, the dates of which lie between 1838 and 1842, during the time when he devoted most of his attention to this subject.

CRANK LATHE.

The first thing to be noticed is a crank turning lathe, shown in Figs. 1 and 2, dating from 1840. It was arranged especially for turning cranked axles and engine shafts, with a face plate at each end provided with chucks to set the ends of the shaft eccentrically. The present drawing was not made for constructive purposes, but only to show the manner of operating, hence the tool supports and other details are omitted. The general design is, however, clear. Both face plates are driven by a through shaft beneath and pinions gearing into the face plates as indicated in Fig. 2.

The gripping jaws, or chucks on the face plates, are well designed and are traversed by screws not shown in the drawing. The face plate driving shaft extends back at *A* to separate driving gearing, shown in plan at Fig. 3. This gearing which is quite clear in the drawing, except the stop motion, can hardly be considered an example of tool design, but is one of those schemes that sometimes lead the best constructors off into the field of "motions" instead of "objects." It is reproduced here to show the pro-

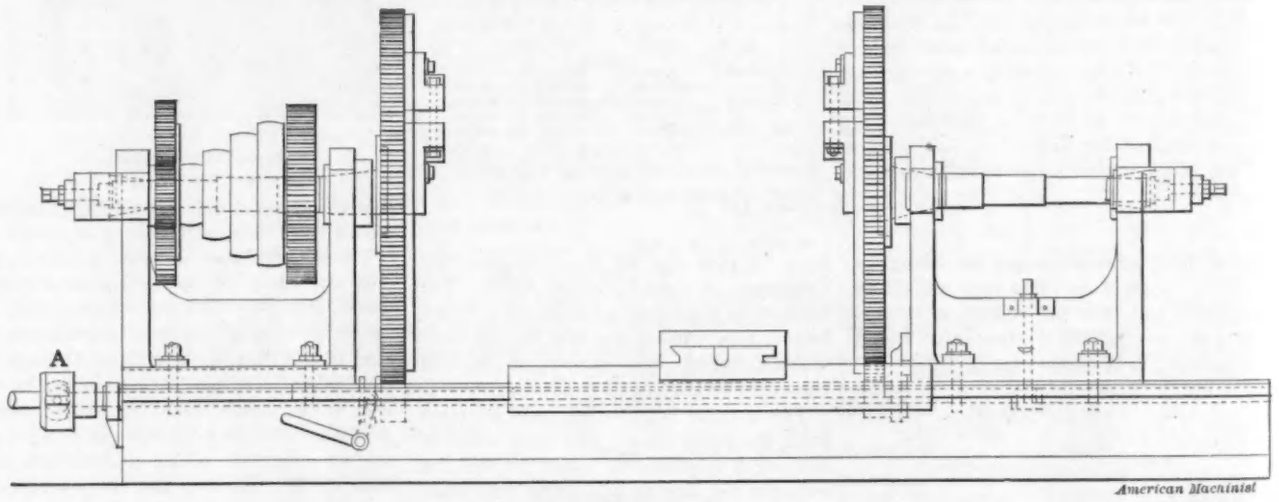


Fig. 1

BODMER'S CRANK LATHE.

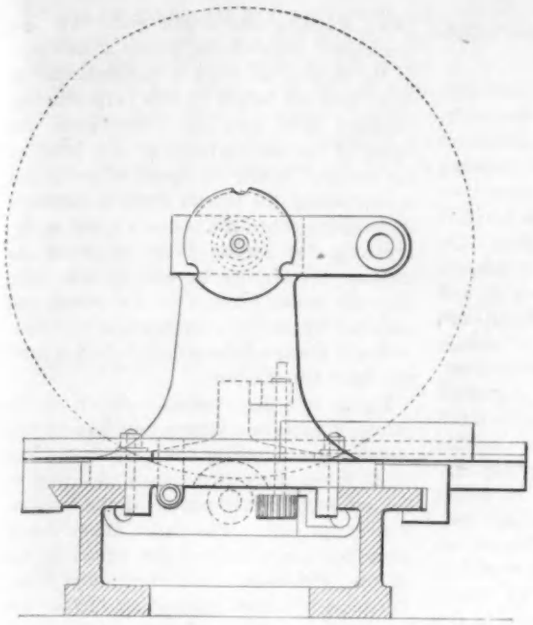


Fig. 2
END VIEW OF BODMER'S CRANK LATHE.

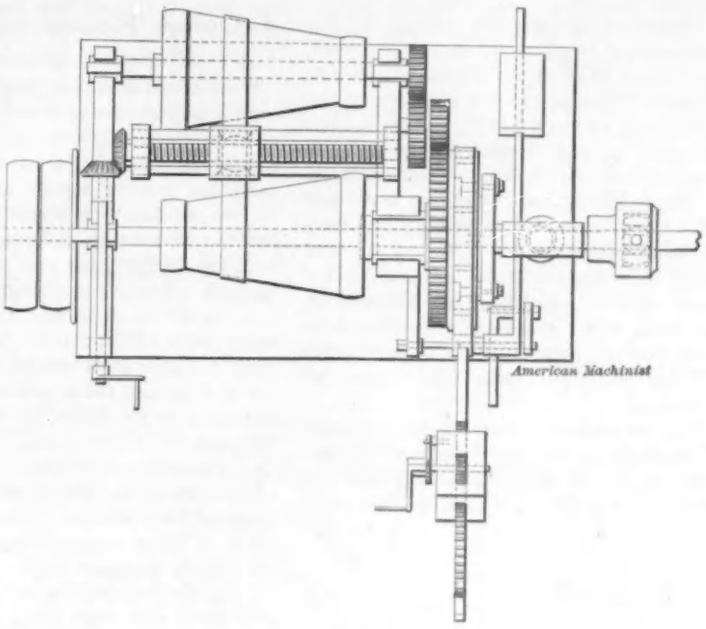


Fig. 3
FEED GEAR OF CRANK LATHE.

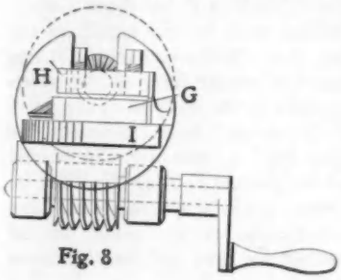


Fig. 8

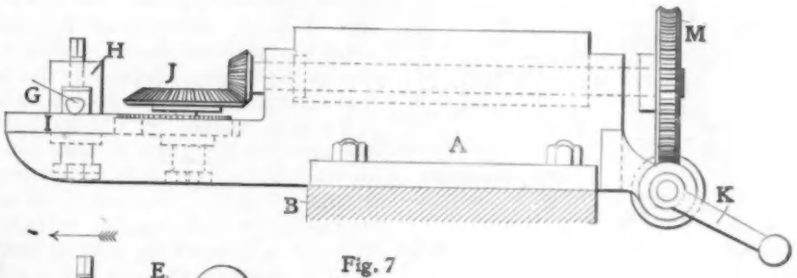
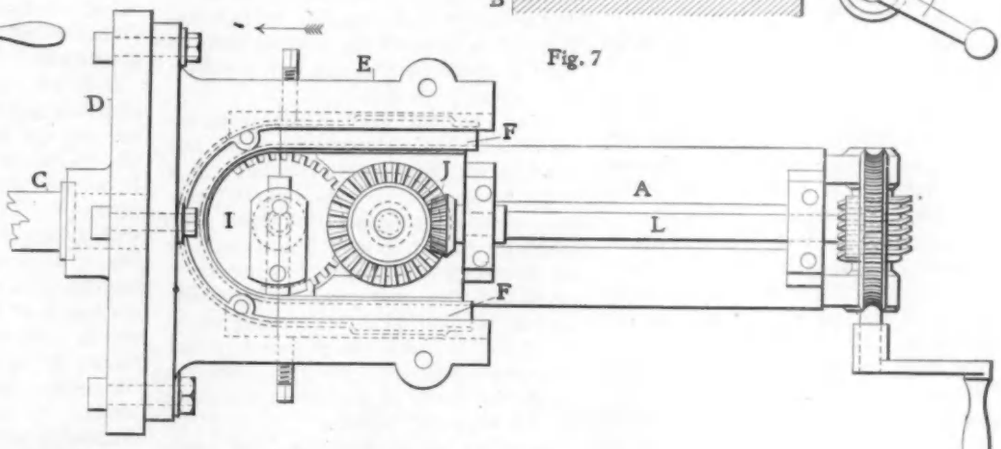


Fig. 7



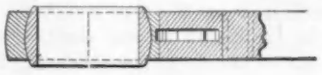


Fig. 4

Fig. 9
FIXTURE FOR BORING THE STRAP FOR SPHERICAL BRASSES.
American Machinist

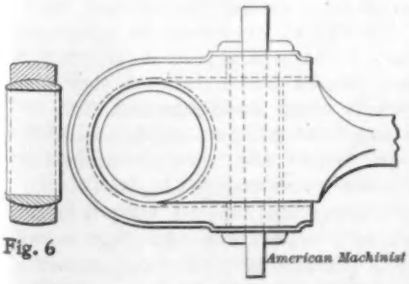


Fig. 6

Fig. 5
BODMER'S BALL AND SOCKET STUB-END.

portions and disposition of parts, which is certainly creditable for 1840. The graduated change of speed by means of the conical pulleys is a refinement not required by the work; so also the stop motion which consists of a pair of tumbling wheels and a strap brake not worth describing. Very few contrivances of this kind will be found in Bodmer's design.

Mr. Bodmer made a good many steam engines, and he may be called the pioneer of high speed, which he attempted to attain by double pistons that mutually compensated their momentum, a device that has come up many times since his day. He also seems to have been the first to invert the cylinder and put it on top of a steeple frame, after the manner of the marine type of our day, and fast becoming the standard type for all engines. In his high speed engines such framing and foundations as were then employed permitted a good deal of flexure and vibration, leading to difficulty with the crank pins, which difficulty he overcame by means of ball and socket bearings, which, so far as known, were the first made.

SPHERICAL BEARINGS.

These facts are mentioned preliminary to explaining the ingenious implements

prepared by Bodmer for making the ball and socket bearings for connecting rods, as shown in Figs. 4, 5 and 6. One of these implements, the one for working out the inside of the straps is shown in Figs. 7, 8 and 9. *A* is a stock or base plate to be fastened on the lathe slide rest *B*. *C* is the lathe spindle, *D* the face plate, and *E* a chuck to hold a connecting rod strap *F*, to be turned on the inside. *G* is a tool held in a post *H*, made integral with a spur wheel *I*, capable of being turned by a pinion under the bevel wheel *J* and by the shaft *L*, tangent wheel *M* and crank *K*, as will be understood from the drawing.

At the beginning the slide or base piece *A* is drawn back so that the tool *G* will clear the end of the strap. The slide rest and the base *A* are fed forward, the tool turning out the inside of the strap up to the point where the curved or spherical portion begins. Then the slide is fastened, and by turning the handle *K*, the tool *G* is revolved about the axis of the wheel *I*, finishing out the curved end truly spherical, and, of course, matching the sides because the tool at the same setting passes over all of the surfaces under the same conditions.

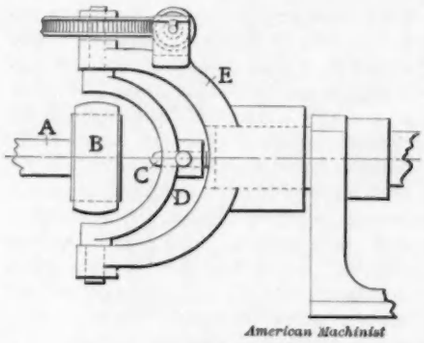


Fig. 10

FIXTURE FOR TURNING SPHERICAL BRASSES.

We might perhaps at this day devise a better way of doing this job, but it is doubtful. Of course, all this expensive fitting could be substituted by a spherical crank pin, such as is sometimes made, but supposing the strap to be made to receive spherical brasses and fit on a turned stub-end, the implement is certainly ingenious.

To prepare the brasses to fit in the straps there was another contrivance of an ingenious kind, shown in Fig. 10, where *A* is the lathe spindle, *B* the brasses to be turned, *C* the tool held in a pivoted radius bar *D*, supported in a frame *E* attached to the fixed spindle of the lathe. The tool when cutting is, of course, swung around in contact with the work. In the absence of swivel tool rests this might be called ingenious, but would be an antiquated expedient at this day.

A Curious Problem in Balancing.

BY CHARLES P. PAULDING.

Now that high-speed engines and motors of all sorts are so prevalent, the problem of balancing the shaking forces caused by the inertia of their moving parts has become a very important one. At sea we find it a necessity in torpedo boats, and even in Atlantic liners. On land the electric light and power stations have paid dearly for disregarding it, and now the designers of motor carriages and auto-trucks will find it to their advantage to give it their most careful consideration.

Not long ago the writer was consulted in regard to the balancing of some small compressors which were giving trouble by their tendency to set up very unpleasant vibrations in the buildings in which they had been placed. The machines consisted of seven single-acting cylinders set radially to a single shaft. An eccentric on this shaft drove the pistons by means of a sleeve and short shoes pivoted in the pistons. The sleeve carried flanges which drew the pistons back through the return or suction stroke by means of the above mentioned shoes. The speed was 475 turns per minute, and the shaking force was about 95 pounds, or nearly half the weight of the machine. As this force was applied as a pull on the holding bolts 475 times a minute, and was applied with the same frequency as a blow on the base of the machine, we can easily understand the cause of the disagreeable vibration. In the design of the machine, no care had been taken to make the moving parts as light as possible, nor had any provision been made for balancing.

It will be seen that the mechanical arrangement is equivalent, as far as the motion of the pistons is concerned, to a single crank pin at the center of the eccentric, with a connecting rod from this crank pin to each piston. The shoes were so short and their angular movement so small that they may properly be considered as having only a reciprocating movement identical with the pistons to which they were attached. We may then calculate the inertia of the pistons and shoes by the ordinary formulæ.

It might be supposed that the seven pistons would to some extent balance each other, but it will be shown here that when we combine their inertia forces, each piston helps to swell the resultant total. Stranger still, this resulant is a constant, both as to value and direction, relative to the imaginary crank.

Each piston with its shoe weighed 4 2-10 pounds; the stroke was 2 inches; the length of the imaginary connecting rods was 5¼ times the length of the half stroke, or "5¼ cranks," as it is called, and the revolutions per minute were 475. With these data we construct the curve *O O O*, shown in Fig. 1. The method of doing this is too well known to require explanation here; suffice it to say that the line *M N* represents the stroke of the engine, *N* being the crank end. To find the inertia force of the piston at any part of the stroke, we draw a perpendicular to *M N*, and the length of this perpendicular between *M N* and the curve gives the value of the inertia force at that point of the stroke. When the speed of the piston is increasing, the inertia force is opposing its motion; when the piston's speed is decreasing, the inertia force is aiding its motion. It may be as well to note here that the forces exerted on the piston and cylinder by the gas undergoing compression are always balanced and do not tend to shake the machine.

Fig. 2 is a diagrammatic sketch of the machine with one piston and two of the imaginary connecting rods drawn in. The small inner circle is the path of center of the eccentric or the center of the imaginary crank pin. The large inner circle gives the inner limit of the stroke of the pistons; the outer circle, their outer limit. Fortunately, the connecting rods are imaginary, so we need not compute their inertia forces.

Taking any position of the center of the eccentric, such as *P*, we draw a circle with a radius equal to the length of the connecting rods. The intersections of this circle with the center lines of the seven cylinders gives us the position of the seven pistons. Knowing these positions, we can, from Fig. 1, measure the inertia forces of the pistons and lay them out on Fig. 2 with their proper direction and value, all applied at the center of the shaft, and we can then find their resultant graphically.

It is only necessary to follow out the graphical construction for one of the pistons, as the principles are the same for all. With the center of the eccentric at *P*, we find that *S* is the position of the piston *F*. Taking off the distance *F S* with a pair of dividers, we transfer it to Fig. 1, measuring from *M* along the base line *M N*. This gives the point *F*, and the length of the perpendicular *F f* is the inertia force of the piston *F* at this moment. By inspection of Fig. 2 we see that the piston is nearing the end of its inward stroke, and that its velocity is therefore decreasing and the inertia force tending to push it along. We then lay off the force *F f* at the center of the shaft acting in the line of motion of the piston *F*. Treating each of the seven pistons in this way, we get seven forces at the center of the shaft. Combining these seven forces graphically, we get the resultant shown in the figure. If, instead of considering these forces to be applied at the center of the shaft, we resolve them into their components along the connecting rods and thus get the seven components all at the crank pin, we will on combining them get precisely the same result as before.

Whatever position we choose for the pin in its path around the shaft we will get a resultant having the same numerical value and always acting along the line

joining the crank pin to the center of the shaft. Furthermore, we will find that the value of this resultant varies as the square of the turns per minute. It follows from these two facts that if we put a counter-weight on the shaft exactly opposite the center of the eccentric, and of such a weight and position of center of gravity as to develop a centrifugal force equal to the resultant force found above, we will have balanced the piston inertia forces of the machine for any speed of rotation. We would then add a certain amount to this same counter-weight to balance the eccentric and the ring surrounding it, on

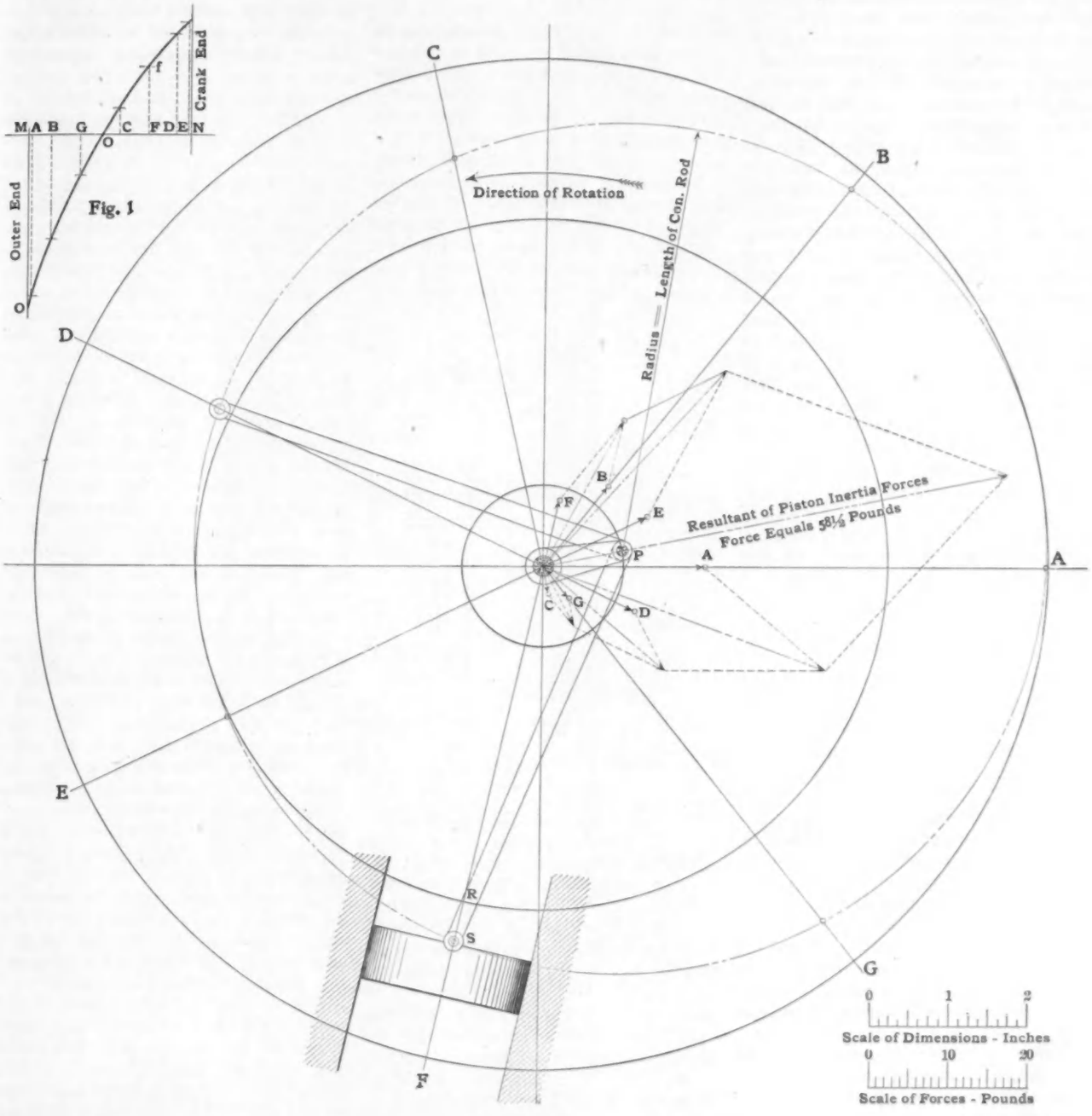


Fig. 2

A PROBLEM IN BALANCING.

from some outside source to the main shaft.

The well-known Brotherhood engine is of this type, having three cylinders set radially and connected to one crank pin. Whether or not the facts brought out in this article have been taken advantage of in the balancing of that engine, the writer is unaware; but it has probably been balanced experimentally with an ease explained by the principles here shown.

The original computations of the value of the resultant force were made on a scale of 1 inch to 20 pounds. Three or four determinations were made with the eccentric in various positions, and the values of the resultant in no case varied more than 1 per cent. This work is, I think, a very good example of the value of graphical computation to the engineer who has not time to keep in touch with mathematics, and in any case it seems to me that when possible to use graphical methods they are always more satisfactory.

Cupola Capacity—Tuyere Area and Arrangement—Blast Pressure—Charging Cupolas—Design for a Cupola.

BY L. C. JEWETT.

The rules for the melting capacity of cupolas followed by builders of cupolas, blowers and fans are unknown to me, but the tables put out by the makers of blowers and fans are, according to my experience, under rather than over actual results. The capacity of a cupola depends so much on pressure of blast, its evenness, tuyere area, quality of fuel, iron, how prepared, charging of cupola, etc., that there can be a wide difference in results. An approximate rule, quite safe to follow, is to allow, with anthracite coal, 7 pounds of iron per hour per square inch of area of cupola; with Connellsville coke, 9½ pounds of iron per hour per square inch of area of cupola; this with a blast pressure of from 8 to 10 ounces per square inch in air pipe, and for cupolas of from 24 to 38 or 40 inches diameter inside of lining. This is below the actual performance of many cupolas. Especially is this true with two rows of tuyeres, and above 40 inches diameter. A 24-inch cupola, inside of lining, would, with above conditions, melt with anthracite coal 3,100 pounds per hour; with Connellsville coke, 4,275 pounds per hour. If iron is broken short, charged

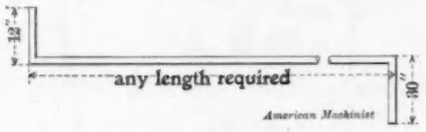


FIG. I. FULL GAGE.

evenly, and snug, fuel is of good quality, and all conditions right, this, I think, is a low rating.

To those contemplating building cupolas the following suggestions may be useful:

One and first is, do not build a cupola to line up to 24 inches unless it is for occasional use only, or unless it is to be put on trunnions, so it can be turned down to be chipped out or daubed up; 24 inches is too small to allow a man or boy to work inside to advantage. Twenty-six inches is the smallest size a cupola in frequent service should be made.

The combined area of tuyeres should be at least 25 per cent. greater than area of cupola, and the same is true of the blowpipe. The tuyeres continue to be reduced in area during time of blast from start to finish. Tuyeres are better if made tapering, as iron or slag is easily removed from a taper tuyere, if they get into them, and get in they will. There should be one tuyere 1½ inches lower than all the others. This low one should be placed above tapping hole, with peek hole so made that the person tapping out can see clearly into bottom of this tuyere, that early warning may be had to tap out. It is better to have the shell sufficiently large for double lining as far up as charging door if possible. This costs no more to erect, or for trimming, and allows for easy enlargement of capacity at small expense and short notice. It is better to have the two lower sheets ¼ inch thick, as they are subject to more corrosion, and sometimes

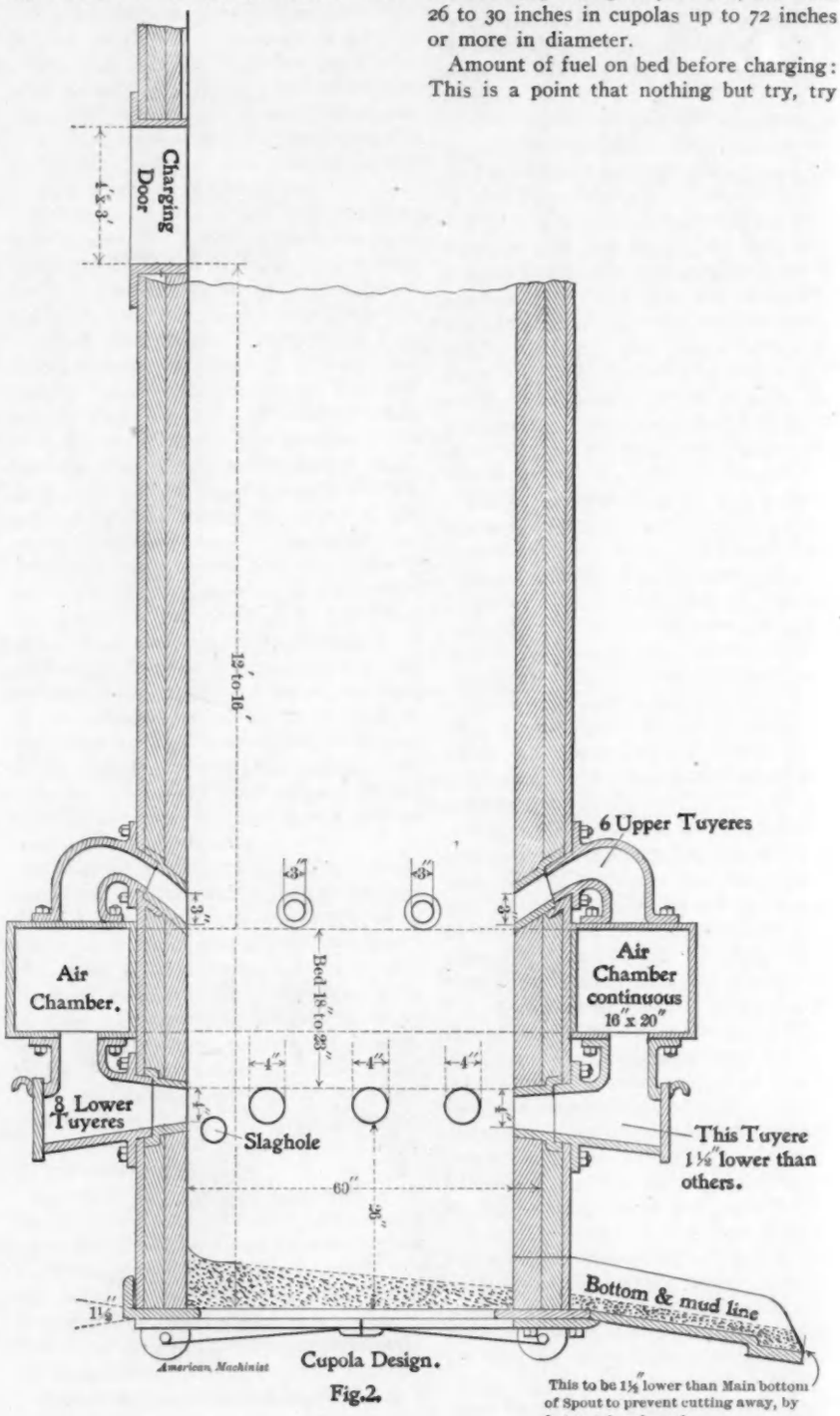


Fig. 2.

if the lining gets thin or a brick falls out, the cupola will go through the heat if necessary and not burn through. Two rows of tuyeres, separated 16 or 20 inches, are good practice, notwithstanding there are many who think there is no particular benefit in this arrangement, but it certainly distributes the oxygen better, causing more complete combustion, generating heat higher up, and lengthening the melting zone, while more iron is melted with the increased units of heat thus obtained. The hight of the first row of tuyeres above the bottom doors should be from 18 to 20 inches in cupolas up to 40 inches, and from 26 to 30 inches in cupolas up to 72 inches or more in diameter.

Amount of fuel on bed before charging: This is a point that nothing but try, try again will determine with exactness, and when found it will require constant watching and some little variation, as the best-priced fuel will vary in firmness when ignited, and the hight of bed will have to be regulated to suit the character of the fuel, pressure of blast, etc. The safe rule to follow at first is to have the bed too

high, rather than too low, especially with a new outfit. The hight above lower tuyeres for anthracite coal should be 18 or 20 inches; with best Connellsville coke, 20 to 23 inches. If the blast pressure is low, say 6 to 8 ounces per square inch in blow-pipe, the levels given will be found high; if pressure is 12 to 14 ounces per square inch, they will be found about right; but to have bed too high is a good fault, and will be known by slow, but hot melting, and at the next heat the bed can be lowered, and in a few heats the best hight and point to have the bed will be determined. And then the thing to do is to keep it there.

The amount of iron to be charged on the bed is from 400 to 600 pounds for every 100 pounds of fuel in bed, when this is put in even and with pig, in radiating lines from the center if possible. Then follow with a charge of fuel equal to about 10 per cent. of the amount charged in the bed. The bed and subsequent charges of fuel should be put in evenly and level. The next charge of iron can be the same, or nearly so, as the first, and so on through the heat; but, as before mentioned, changes can be made as practice and experience may suggest after a few heats are taken off. The one thing paramount to all others in cupola practice is to keep the fuel up to the point of best combustion; the more constant this is done, the better the results.

Charges of iron and fuel: If coke is used, the burden must be lighter than with anthracite coal for fuel, as it consumes faster, bulk for bulk. To get the hight of the bed even, and to a certainty, from day to day, I have found a gage made of ⅝-inch iron (see Fig. 1) very useful. The length of long part should equal the hight desired above lower tuyeres to 3 or 4 inches above bottom of charging door, and to be measured off before putting up the cupola bottom doors. When kindling wood is all burned out and fire going well, bring the level of bed up to hight laid out by the gage, and proceed to charge the iron. A gage is more reliable than weighing of fuel, as there is considerable variation in bulk as per weight in different good fuels, and some days fuel consumes more than others, and bed is either higher or lower in consequence. It is a very good plan not to put all the bed on at once, saving out a portion until about ready to charge the iron, then bring it up with fresh fuel to the gage marks, and variations in heat will be much less, and a degree of certainty will be felt as to final results.

Fig. 2 shows a cupola of which two have been built, from my own plans, and they work well. I consider that this design has some advantages over the Collieau, especially in having less trouble with iron getting into the air chamber through the tuyeres. The design shown may be a little more expensive than the common plan, but the result is a first-class cupola easily taken care of.

A Combined Friction and Positive Clutch.

The illustrations show a clutch for power-transmission machinery which possesses new and interesting features. While a positive clutch is very desirable, and often imperative, it is impossible to use such a clutch when the driver is running at considerable speed and the shaft or wheel to be driven is to be started from a state of rest. In such cases it is necessary to stop or to slow down the driver in order to throw in the clutch, and even then it is not always done without dangerous shock. The clutch here shown combines in one a friction drive for starting, and a positive drive after the driven portion has attained the speed of the driver. The friction drive, which may be used in stopping as well as in starting, also allows of a stoppage as gradual as may be desired.

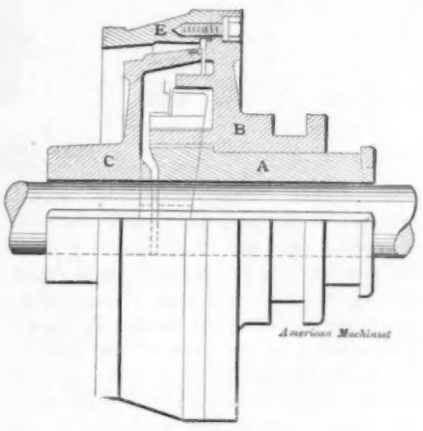


Fig. 1

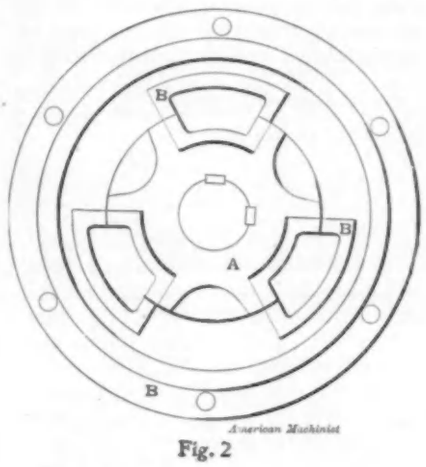


Fig. 2

A FRICTION AND POSITIVE CLUTCH.

The construction and operation of the clutch may be easily understood by reference to the cuts. The ends of two shafts are shown in Fig. 1 with the complete clutch, half in section. Either shaft may be the driver. We assume the shaft at the *left* to drive, and to be running at normal speed, while the shaft at the *right* is to be started and positively clutched to the other. Upon the end of the revolving shaft is securely keyed the casting *C*. This casting has upon its periphery a conical surface for the friction drive, and on its face three jaws for the positive clutch. These jaws are cast attached to the face and also to the interior of the friction rim, but extend radially inward less than one-half the distance from the rim to the shaft. The casting *A* is keyed to the right-hand shaft which is to be driven. This casting has upon its end three jaws whose radial surfaces correspond with the radial surfaces upon C, but the outer diameter of the jaws upon *A* is a little less than the internal diameter of the jaws of *C*. The jaws of *A* and of *C*, then, are in the same radial plane, but do not engage. The sleeve *B* slides upon *A*, being moved in either direction by a forked lever in the usual way. The friction ring E is bolted to the outer edge of *B*, and when *B* is thrown to the right the inner conical surface of *E* engages the outer surface of *C*, and the shaft is driven by the friction of those surfaces. On the face of *B* are also three jaws with radial sides, and small enough to slip into the spaces between the jaws upon *A* and *C*. These jaws of the sliding sleeve *B* are large enough in external diameter so that, when slid to the left, they will have considerable bearing surface against the jaws of C, and they are also small enough in internal diameter to engage the jaws of *A*, so that in this way the jaws of *A* and *C* are so connected by the jaws of *B* that the one is driven by the other, and no torsional strain comes on *B*. The jaws of *B* are of such a length horizontally that when the friction surfaces of *E* and *C* are engaged, those jaws are free from the jaws of *C*; but the friction surfaces being thrown out of contact by the movement of *B* to the left, its jaws are then ready to engage the jaws of C. Those portions of the jaws of *B* which engage in the jaws of *A* project outwardly, or to the left, a certain distance beyond the portions which engage the jaws of *C*, so that when *B* is drawn to the right and its jaws are disengaged from those of *C*, they are still engaged with the jaws of *A*, and, in fact, never lose that engagement.

To start the right-hand shaft, then, *B* is first thrown to the right, and the friction surfaces engage. When the shaft gets up to speed, *B* is thrown to the left, locking the jaws together and making the drive positive. The jaws of *B* may not come opposite the openings in *C*, but the driven shaft need never lose more than one-third of a rotation before they must coincide, and the jaws may then be thrown in, their faces being beveled or tapered to facilitate the operation. In Fig. 2 the jaws of *A* and of *B* are shown, but not

those of *C*, which, when the clutch was positively engaged, would come opposite the three vacant spaces.

This clutch is in successful use in Germany and in England, and has recently been patented in the United States by Jacob Missong, Höchst-on-the-Main, Germany.

A Simple Gas Engine.

The gas engine the essential features of which are illustrated in the accompanying sketches is of the familiar four-cycle type, and in general design is similar to others now in use. The devices for operating the valves and for regulating the speed of rotation are, however, original with this machine. The necessary succession of events in this type of engine is secured in the present instance entirely by the mechanical opening and closing of the exhaust valve. Fig. 1 shows the arrangement of the valves in the cylinder head. Both the exhaust valve and the valve by which the air and gas are admitted open inward, being returned to their seats by springs upon their

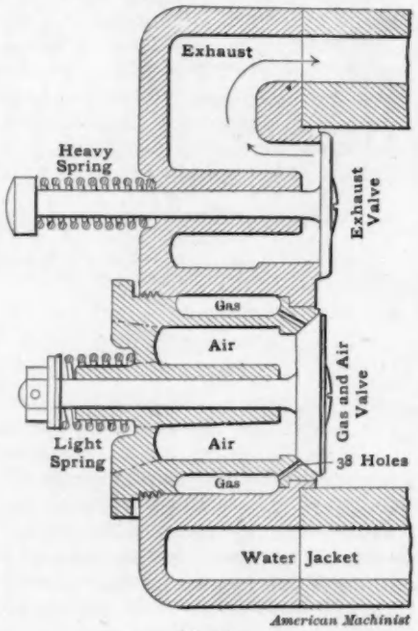


Fig. 1

BACK END OF CYLINDER.

stems, the spring upon the exhaust valve being much stiffer than that upon the air and gas valve. In the regular running of the engine, the exhaust valve is held open, by devices described later, during the entire return stroke of the piston which succeeds the explosion stroke. On the next forward stroke of the piston, the spring of the air valve being so much weaker than the spring of the exhaust valve, the air valve opens by the suction of the piston, and the charge of air and gas freely rushes in. The air passes in through openings in the outer part of the valve casing, as indicated by the dotted lines, while the gas enters by a number of small holes in the valve seat, thus ensuring a thorough mixing of the air and the gas. The operation of the governor, when the speed of the engine rises above normal, is to hold the exhaust valve constantly open, so that the air plays freely in and out of the cylinder, while the air and gas valve remains closed. Then, of course, no explosions occur, and no further power is developed until the speed slackens, when the normal cycle of operations is resumed. In Fig. 2, which is a plan of the engine, the valve-operating mechanism is shown. The lever *a* at the back of the cylinder opens the exhaust valve, and this lever is operated by the thrust of the sliding rod *b*, and this in turn by the eccentric rod *c* in line with it. The light spring *d* on the rod *b* is merely to hold the rod back in contact with lever *a*. Referring to Figs. 3, 4 and 5, it will be seen that the eccentric rod is supported near the middle of it by the vertical rocker *E*, being jointed to a plunger that slides up and down in the rocker. When the head of this plunger is down in contact with the top of the rocker the end of the eccentric rod in its backward stroke strikes into the notch in the end of the sliding rod *b*, and this rod is thrust backward and the exhaust valve is opened as required. On the return stroke of rod *b* and before the eccentric rod leaves it the plunger in the rocker is lifted so that the little lever *h* swings on top of the rocker and holds the plunger up. On the next backward thrust of the eccentric rod, then, the end of it does not strike in the notch in the end of rod *b*, as before, but strikes on top of it, as seen in Fig. 5; then on the return the plunger is lifted a little higher, the little swinging lever is caught by the end of the horizontal lever *g*, pivoted to the frame, and is held from contact with the top of the rocker, so that the plunger then drops clear down to its initial position. The eccentric rod thus alternately hits and misses the sliding rod *b*, or the exhaust valve is only opened on each alternate rotation of the engine shaft as required.

The action of the governor is extremely simple. When the speed of rotation exceeds the limit, the weighted arms operate the sliding sleeve *t* and the lever *u*, and

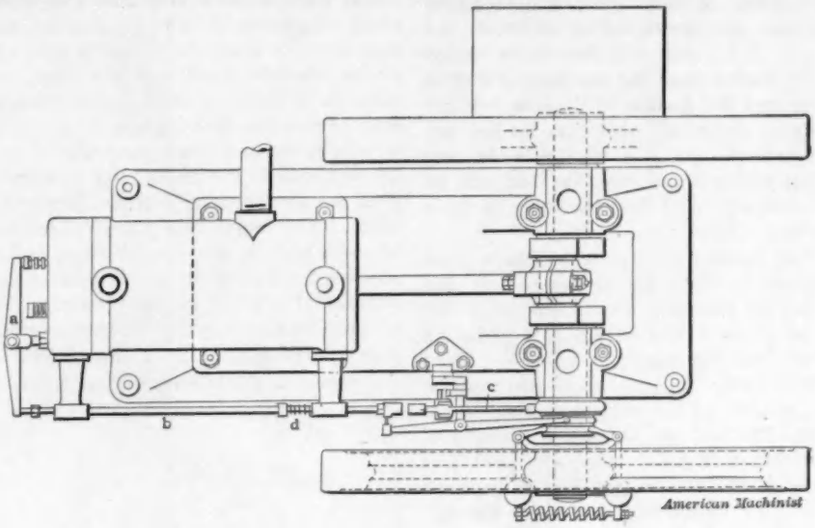


Fig. 2

PLAN OF GAS ENGINE.

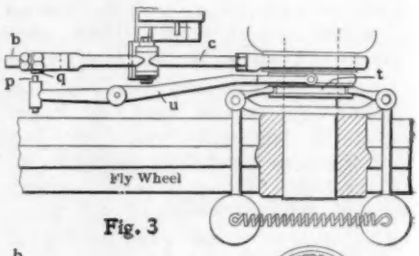


Fig. 3

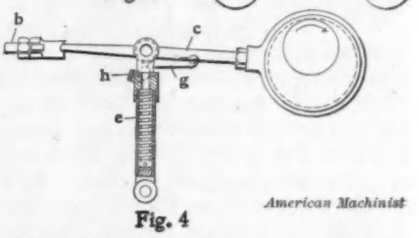


Fig. 4

EXHAUST VALVE MOTION AND GOVERNOR.

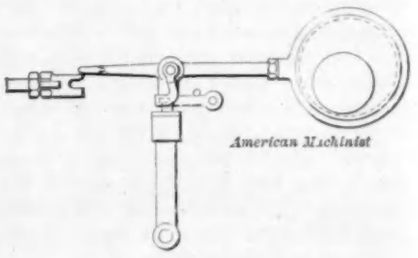


Fig. 5

POSITION OF ROD ON THE ALTERNATE STROKE.

the pin *p* catches a projection *q* on the end of the sliding rod *b*, and the exhaust valve is held open until the speed falls and the pin *p* is withdrawn, when the normal cycle of operations is resumed.

This arrangement was designed by Harry J. Perkins, Grand Rapids, Mich.

Die Construction.

BY GEO. B. PAINTER.

Fig. 1 in the accompanying sketch shows an elevation of a combination piercing, shearing and bending die, for producing in one operation an article like Fig. 2, and is adapted to a large variety of work. Figs. 3, 4, 5 and 6 show some of the varieties which have been produced in dies of similar construction. The die-bed *A* is a flat plate, preferably a steel casting, slotted to admit the forming die *D* and the piercing and shearing die *B* to be screwed and doweled thereto. The die-bed *A* is tapped out directly under the forming die *D*, and the stud *L* is screwed in.

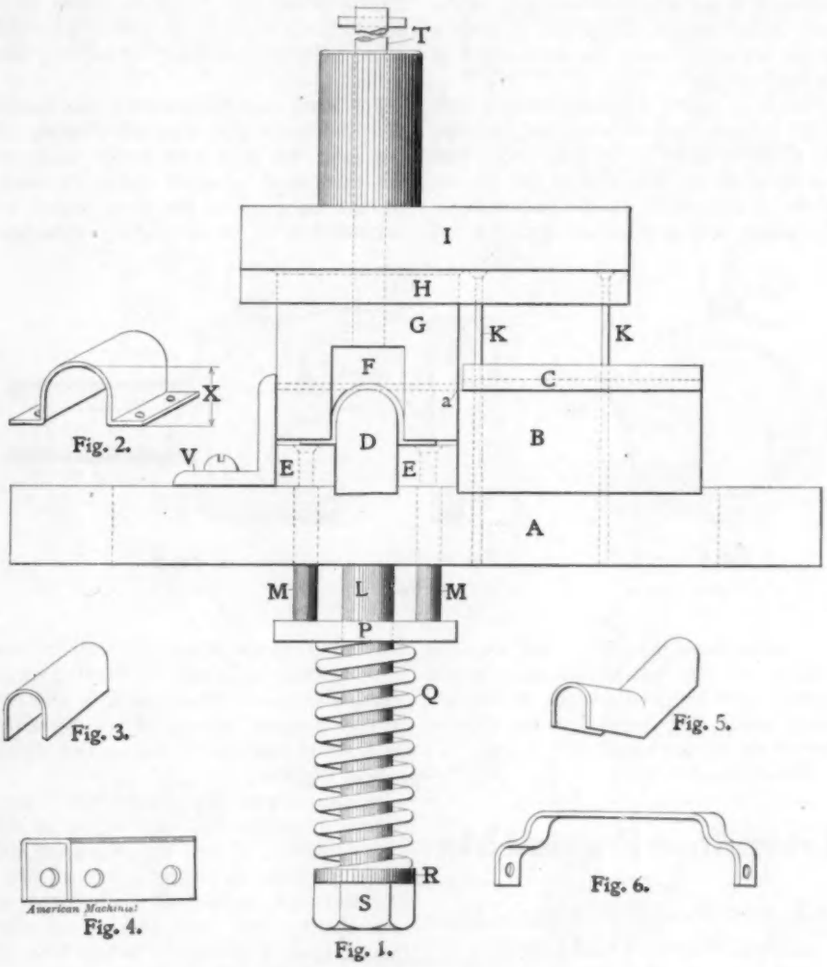


Fig. 2.

Fig. 3.

Fig. 4.

American Machinist

Fig. 5.

Fig. 6.

Fig. 1.

A PIERCING, SHEARING AND BENDING DIE AND ITS WORK.

The pads *E* have four pins *M* riveted into them; these pins working through the die-bed onto the plate *P*, which is forced upward by the action of the spiral spring *Q*. In making a shape like Fig. 2, it is necessary that the thickness of the pads be such that they will bottom on the die-bed when the distance from their upper faces to the top of the forming die *D* equals the distance *X*, Fig. 2. The length of the pins *M* must be such that when the plate *P* is forced against the bottom of the die-bed the upper faces of the pads *E* will be on a level with the forming die *D* and the piercing and shearing die *B*.

The shearing and forming punch *G* should come directly under the shank of the punch holder, to allow the working of the knock-out *F* which is actuated by the lever of the press on the top of the rod *T*, on the upward stroke, thus freeing the punch *G* of the finished article. The press being set on an incline, the finished piece falls out of the way by gravity, thus allowing the continuous working of the die.

The top of the forming die *D* should be the same hight as the piercing and shearing die B, so that the pressure of the shearing punch G will be upon the blank before the act of shearing takes place. The blank is represented by the dotted lines at the top of the forming die *D*. The shearing edge of the die *B* is represented at *a*.

The production from a well-made die of the above description is very large, the work is uniform and satisfactory, and there is no waste of material.

In one recent day twenty companies were incorporated in New Jersey whose combined authorized capital is $128,600,000.

Trial-Rims made in Screw Machine.

BY A. H. CLEAVES.

Having described (in issue April 20) the punches and dies and their operations in producing trial-rims, the following is offered as a brief description of getting at the same result in another way, viz., by the turret lathe.

The blank *C*, Fig. 1, is a brass punching furnished by some of the brass companies in the shape shown. This ring is held in a

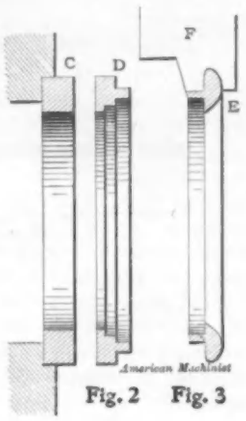


Fig. 2 Fig. 3

Fig. 1

METHOD OF HOLDING AND THE CUTS.

chuck, as shown at *C*, and the cuts shown at *D*, Fig. 2, are made first; the outside corner being made with a front or back tool, and the inside ones with the special tool shown in Fig. 4.

The piece is next held by an inside chuck like Fig. 5, the outer circle made with a back tool *F*, Fig. 3, and the inside

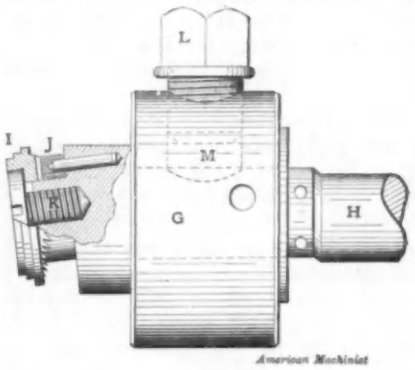


Fig. 4

CLEAVES' SCREW MACHINE TOOL.

curve joining it made with the special tool shown in Figs. 6, 7 and 8.

The tool shown in Fig. 4 is of my own design, and has been pretty thoroughly tested and found serviceable. The body of the tool *G* is made of machine steel, and is held on an eccentric stud *H*, which admits of adjusting the tool in or out within needed limits; a large fine-threaded set-screw *L* with brass seat *M* secures the same in position. *G* has a projection with an angle suitable for clearance for the cutter *I*. This cutter has fine teeth to match

those in the collar *J*, put into the latter rather than in the stud on *G* for convenience in making. The pin in *J* and *G* with the teeth in *I* and *J* keep everything rigidly in position when the screw *K* is turned down. *I* is the usual round cutter with the form-retaining feature, made in lots, and they will cut about 8,000 rings apiece before being used up. The notches

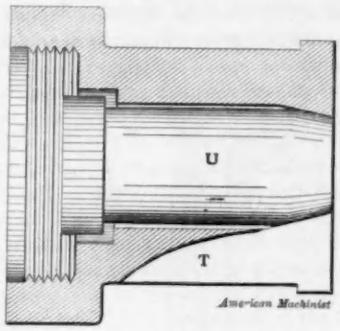


Fig. 5
EXPANDING CHUCK.

or teeth take the strain off of the screw *K*, and the diameter adjustment with *G* and *H* is made easily.

The tool shown in Figs. 6, 7 and 8 is ring *A* held on the plug *B*, and is made to cut on the face; a steep pitch, about the proportion to diameter shown in the drawing, being necessary to get a good clearance.

The chuck shown in Fig. 5 has three slots in *T*, and is expanded as usual with a taper plug like *U;* and the special feature worth mentioning, though not shown in the drawing, is easily told. It consists of fine flutes in the rim of the chuck, which hold the ring firmly while the cut is made with *F* and *A*. This is explained in this way: When nearly finished, the thinnest part of the ring *E* is so delicate that it

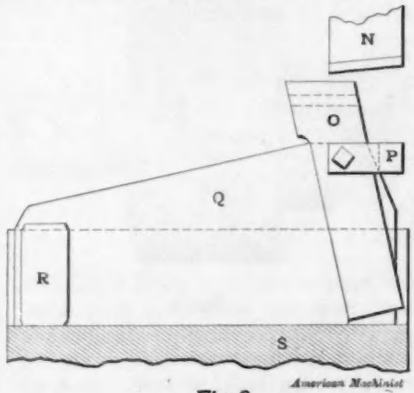


Fig. 9
METHOD OF HOLDING WORK IN SHAPER VISE.

would not hold by simple friction; but in adapting itself to the flutes in the chuck, it is held by angular contact, not sinks in the tock, but conformations so small as not to mar the work, but sufficient to make a firm hold.

Fig. 9, while not germane to this particular topic, comes under the general head of turret-lathe matter, and might wedge in here as well as anywhere.

I had some right and left-hand pedal cone tools to make for turret lathes, being the ordinary tool shown at *O;* right and left hand referring to the thread merely; one being made with a shoulder and one without, to distinguish them in handling. While tools cutting on two sides at once must have only back clearance to retain their form, those cutting on one side only may better have back and side clearance. The former have one side offsetting the other, while the latter, if straight on the side, naturally dull and crowd off.

Casting about for something in the way of a "hand-out" to help the job along, I found a piece of iron in the junk-heap, like *Q*, Fig. 9, having a shoulder on the angle shown, where the tool *O* comes. I dropped this into the shaper-vise *S*, put in a piece *R* to get a hold at both ends of the vise; then brought *O* against *Q* with a Besley clamp to make the work rigid at the top.

Finally, I swung the vise around a little to get the side undercut required, and had the work in shape for making a tool with one form all the way, and to get the use of the angle swivel on the shaper head. The shaper-tool *N* has to go against a stiff piece of stock as the work, while standing high in the vise, has a long brace in the piece *Q*, and the whole width of vise-jaw for a hold. This method, since then, is one of my regular boarders.

Peoria Heights, Ill.

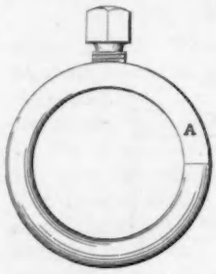


Fig. 6

Fig. 7

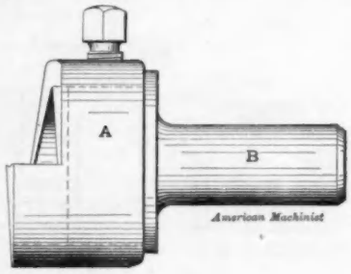


Fig. 8
A FORMED TOOL.

Letters from Practical Men

A Space-Saving Belt Shipper—Planing Water Wheel Chutes and Gates.

Editor American Machinist:

In a shop where there was no room for shipper handles, the expedient of using vertical shafts was employed to operate the belt shifters. In case of a lathe that stood close to one of the steel columns which supported the building, a 1-inch steam pipe was made to do duty as a shaft, being mounted vertically upon the column and about 2 inches therefrom. At a convenient distance from the floor, a lever handle was attached by which the hand could rotate the shaft.

Another lever at the top formed a crank which, by means of a connecting rod, actuated the shipper bar and moved the belt from one pulley to the other. At the next column, which stood close to the other end of the lathe, another vertical pipe shaft was erected, and, being fitted at the top with a crank lever, was connected with the first vertical shaft and crank by means of a stiff wooden rod. A hand lever was also attached to the second shaft, so the lathe belt could be shifted from either end of the lathe.

To enable the lathe belt to be controlled from any point intermediate between the two vertical shafts, a cord was provided, with a hook spliced into each end thereof, of sufficient size to go into a hole in the outer end of each hand lever on the vertical shafts. The machinist has now full control of the belt shifter by simply pulling upon the cord in one direction or the other, either in stopping or starting the lathe.

For work which required close attention and quick and accurate stopping of the lathe, the lathe man would slack off the cord until he could carry the slack thereof right up to the place where he happened to be working. He then had the speed under perfect control without moving from his tracks or reaching up to grasp a shipper. When the lathe was not in use, the cord (a piece of heavy braided sash cord) could be coiled up and placed out of the way.

In planing water-wheel gates and chutes, where it is desirable that all be of the same diameter, so they may move and still allow no water to escape, it is good practice to mount each chute upon centers on the planer. The chute castings are then bored, about a ¾-inch or ⅞-inch hole being made, and a steel arbor is forced into the drilled holes sufficiently tight to hold against the strain of planing.

In the arrangement of the centers on the planer, the back one, or the last to pass under the cutting tool, is mounted as a line center, and carries a gear of any convenient number of teeth, say about sixty. A worm is mounted on a shaft directly underneath gear in line center, and one end of this shaft projects beyond side of planer, but not so much that it will not pass through the housings.

A gear carrying a ratchet device is fitted to outer end of transverse shaft,

and the ratchet lever or handle hangs down just beside the planer table, where it is worked by adjustable stops placed on a rod. In case of the planer here described, the lugs are attached directly to the shifter rod, which controls action of the planer.

The steel arbor upon which the chutes are mounted is so clamped that there is no back-lash, or lost motion. In the case here described, which is in the shop of E. D. Jones & Sons Company, Pittsfield, Mass., the arbor was loose and dogged to the tail center gear; but for special work, the arbor could be checked in a hole drilled in center, thus making it unnecessary to use either a dog or means for rigidly connecting arbor and tail center.

The outer edges of chutes and gates were planed upon the arbor, the radius then being about 10 to 12 inches from the arbor; but as the work of actual cutting was all done vertically over the center of the arbor, there was little torsional strain put upon either the arbor or the work operated upon.

JAMES F. HOBART.

New York.

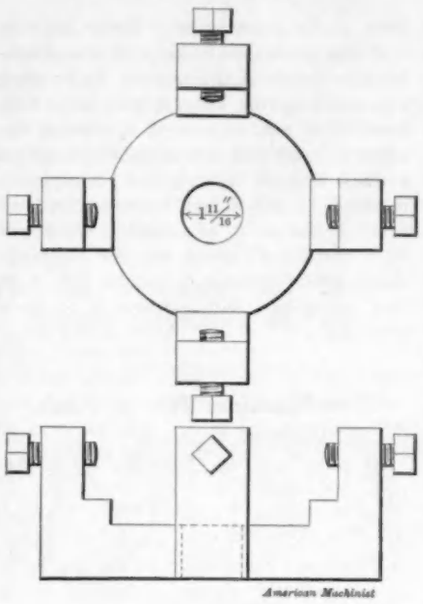


Fig. 1

GUIDES FOR BORING BAR FOR BORING FLY-WHEEL.

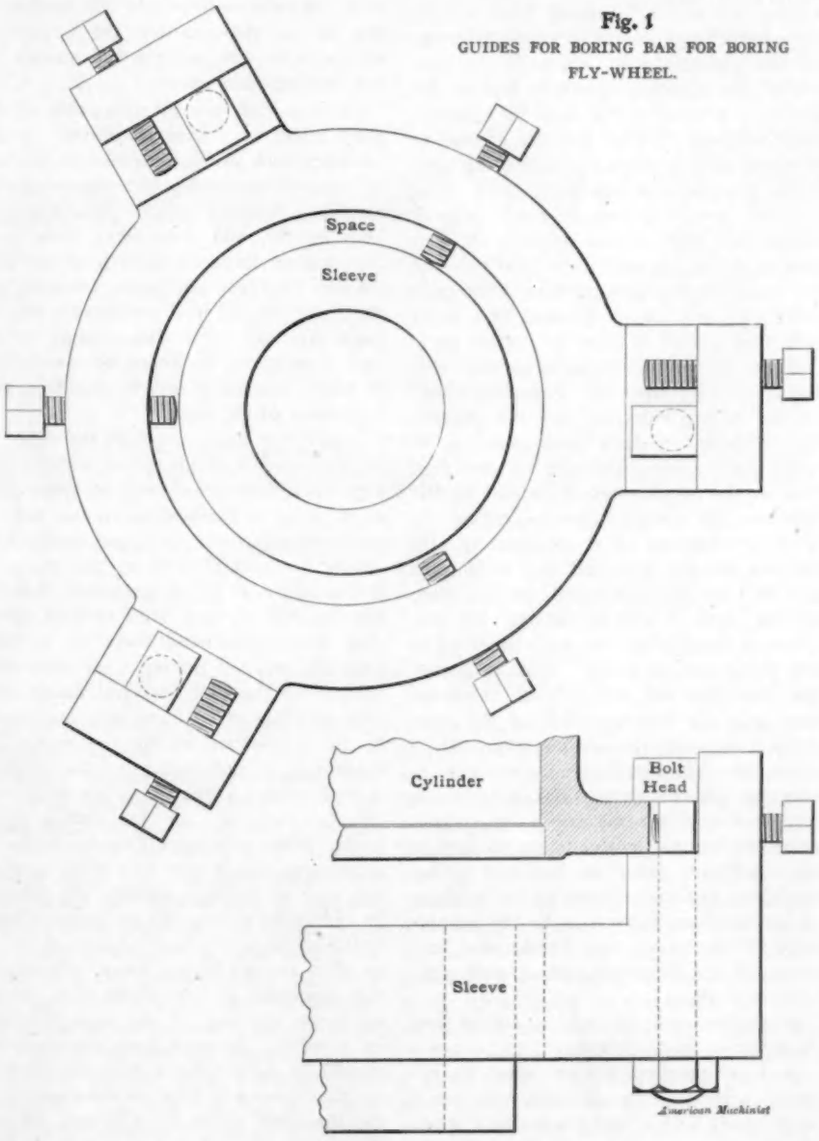


Fig. 2

RIG FOR BORING CYLINDERS IN A LATHE.

Some Boring Rigs.

Editor American Machinist:

The article "Making a Pulley at Argentopolis," in your issue of April 6, recalls some boring jobs in which I was an interested participant.

One was the boring of a fly-wheel for a steam engine; diameter, 5 feet; rim, oval, 6 inches deep, 3½ inches thick at the center; hub, 7 inches long, cored to 2¾ inches. As the largest lathe in the shop was an old chain-feed Chamberlain, blocked up to swing 30 inches, it was decided to bore it by hand, rather than send it out to be done. Some rough-sawed blocks were nailed together for a pattern, as shown in Fig. 1. Two castings were made from it, which were bored to 1 11-16 inches, and set screws were put in the lugs. An old piece of 1 11-16 inch shaft was found, in which a hole was drilled and a cutter put in. This was slipped through the hole in hub, one of the holder castings being placed on each end of the hub and their screws set up. One end of the shaft was put in a pipe vise fastened to a bench, and the other end propped up so that the fly-wheel would clear the floor. The wheel was then trued up by adjusting the lug screws until it ran properly. The cutter was then set out and the wheel rotated by a boy at each side. Three cuts were taken, and the bore made the size wanted, 3 inches. This made a satisfactory job, as no facing or rim-turning was desired. The feeding was done by wedging between the vise and one of the holder castings. The offset lugs allowed free access to the cutter.

A number of steam-engine cylinders, 7x12 inches, were held while being bored in a somewhat similar casting, but with a separate sleeve for the bearing on the bar, as shown in Fig. 2. The boring bar in this case was an old car axle turned to 3½ inches diameter and fitted closely in the sleeve. The holder castings were bolted to the cylinder flanges, the sleeves were put in place, and the bar slipped through and put on the lathe centers. The cylinder was trued up by adjusting the set screws holding the sleeves. The only finish on the ends of the cylinder was to face off the projecting ring. One of the lugs on the holder-ring rested on the tool-block of carriage to keep the cylinder from turning, and it was fed by the butt of a tool clamped in the tool-post.

In another shop, of which I had charge, a change was made in some of the lines of shafting, necessitating the putting on of a 48x8-inch pulley. Four of us staid one night to put it on. After taking down a hanger and removing other pulleys which were in the way, it was found that while the shaft was 2½ inches, through

some mistake the pulley was bored to 2 3-16 inches, and was key-seated. As we had gone so far with the job, it was decided to bore it out by hand, if possible, and thus save the delay of sending it out to be bored, and then staying some other night to put it on.

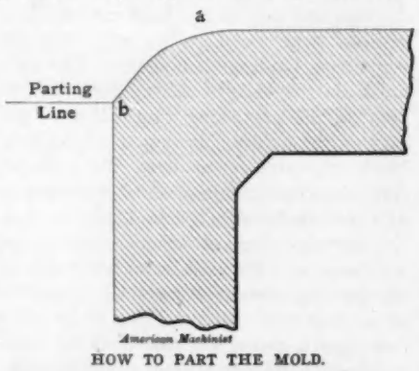
A short piece of 1 7-16 inch shafting which we used for a boring bar, and three collars to fit it were found. One of these was turned to 2 3-16 inches outside diameter; another to 2 3-16 inches for about half of its length, and the third one to 2½ inches for half its length, and a hole was drilled in bar for a cutter. One end of the bar was held in a pipe vise on a bench. The 2 3-16 inch collar with flange was put on, flange first, then the pulley, followed by the plain 2 3-16 inch collar, and last the 2½-inch flanged collar, flange last. The other end of the bar was propped up, the pulley was put on the flanged 2 3-16 inch collar, and the plain 2 3-16 inch collar was pushed into the other end of the hub, allowing about 1 inch of bore to show. The cutter was now inserted between the end of the hub and the 2½-inch collar, the hole having been properly located previously and set out until it would enlarge the bore to 2½ inches. The pulley was rotated by hand and fed to the cutter by wedging between the pipe vise and the hub of the pulley. After having bored about 1 inch deep, the 2½-inch collar was pushed in the end of the new bore, and the boring was continued, the cutter pushing the 2 3-16 inch collar ahead of it until it was pushed out of the other end, and the boring was completed. Care was taken to make the tool cut the proper size, as a second cut could not have been taken with the same collars. There was enough key-seat left to use as it was. As we completed the job, and had everything in place, and were washing up before 9 o'clock, we felt well satisfied with the night's work. Turning the collars and drilling the hole for the cutter was all done by pulling the lathe by hand.

WM. HOLLINGSWORTH.

How to Part the Mold.

Editor American Machinist:

Your engraver improved altogether too much on my rough sketch which was used



HOW TO PART THE MOLD.

to illustrate the notion about the parting line on the round-cornered casting. I enclose a new drawing to a larger scale to make the point clear. Our way is to chamfer the corner of the pattern, as is usual for rounding the corner, and then only round that part shown at *a*, leaving the angle at *b* without rounding, which leaves a sharp line for locating the parting, and if there is any offset between the two parts of the mold, as is likely, there will be a surplus of metal for the chipping-chisel artist to make a finished job of it. Our experience demonstrates it to be a good way.

JOHN E. SWEET.

The Machinist Not at Fault.

Editor American Machinist:

In your issue of December 29 an article appeared over the signature of "Superintendent," entitled "The Machinist at Fault." In this article the habits and customs of machinists are set forth in a way that is simply misleading to the average employer. Coming from a man who has charge of the business interests of the concern with which he is connected, the testimony given by him in this article is directly in line with the universally accepted theories that are applied to working men in most manufacturing concerns, especially to machinists as a class.

Now, there is more at stake in such statements than would appear at first reading an article such as the one referred to. And there is another side to the case. It is with a view to showing this other side that I wish to take the matter up.

First, let us review in a general way the complaints made by "Superintendent" in the article referred to. He charges the machinist with wilfully planning to work his machine with the lightest feed that would be tolerated if noticed by the foreman in charge, thereby failing to work the machine up to its capacity. He further charges that dull and unfit tools are kept on the lathe board, so that when needed, time is lost by leaving the machine to stand while the tools referred to are being put in order. Belts, likewise, are neglected and left in such condition that when a cut approaching the machine's capacity has to be taken, or is taken, the belt then figures as a factor in causing loss of time. The machine is neglected in a general way as to cleanliness, dirt being a matter of no concern to the workman, and it is permitted to accumulate, to the detriment of the working of the machine as well as to the appearance of the same, and breaks the harmony of the otherwise cleanly and well-appointed shop.

Now, the other side of the matter may be summed up as follows:

A superintendent knows what he expects to be done in all cases, whether it be in matters of working a machine up to its capacity or as to matters of cleanliness. In the care of the machines and the shop generally, the fact is proven by his statement. It is therefore resolved back to a question of why he did not direct the workman to do what he expected to have done; and if the matter was not attended to, why he did not call for an explanation as to the reason on the part of the workman for not having done so. There is no doubt but that a reason exists in the mind of the workman in such cases.

It is not making a strong statement to say that men are often both misrepresented and misunderstood in many of their actions by having motives attributed to them which they are happily above entertaining.

It is plainly the duty of a superintendent to convey his wishes fully to the minds of his workmen, and to see that he is understood by them. If this is done by him there can be no reason why he should have cause to complain, or to state, as a confession of his own weakness, that men do not perform their plain duty for him. In such cases he has full redress, in that he can dispense with the services of men who do not perform full service for him and get men who will do so.

Another bad side to statements of the kind made by "Superintendent" is the tendency such articles exercise in the way of intensifying a spirit of antagonism that already sufficiently exists. Machinists are only mortal, and, like other men, have that natural dread of seeming to see their chances for bread and butter cut into, and should be treated in a considerate way by employers and given time enough to adjust themselves to improved conditions, in which machinists will be benefited perhaps most of all men.

In order to keep pace with the times, as to improved methods, shop owners and superintendents should inform themselves as to what is being done in the way of improved apparatus, tools and methods, by which it would be seen by the writer of the article now being discussed, that for him to talk of men who operate up-to-date lathes and work them up to their capacity, and yet getting their own tools dressed at the tool fire, and doing their own grinding of all tools, may consistently be complained of by the up-to-date machinist for not having a better system. A man cannot always keep his lathe running if he has all his tool-grinding to do. Also with respect to the matter of cleanliness. It is true that some cleaning can, and no doubt is done by the machinist, while he gets credit for none. But a time should be set apart, once a week, or as often as may be necessary, to maintain the standard of cleanliness that would meet the approval of the superintendent in question. At such time an inspection should be made by the superintendent to see that the work done on the cleaning of the machines meets his approval, so that if the time allotted is not enough, it may become known, as it takes several times as long to clean some machines as it does others. Some machines, as in cases where

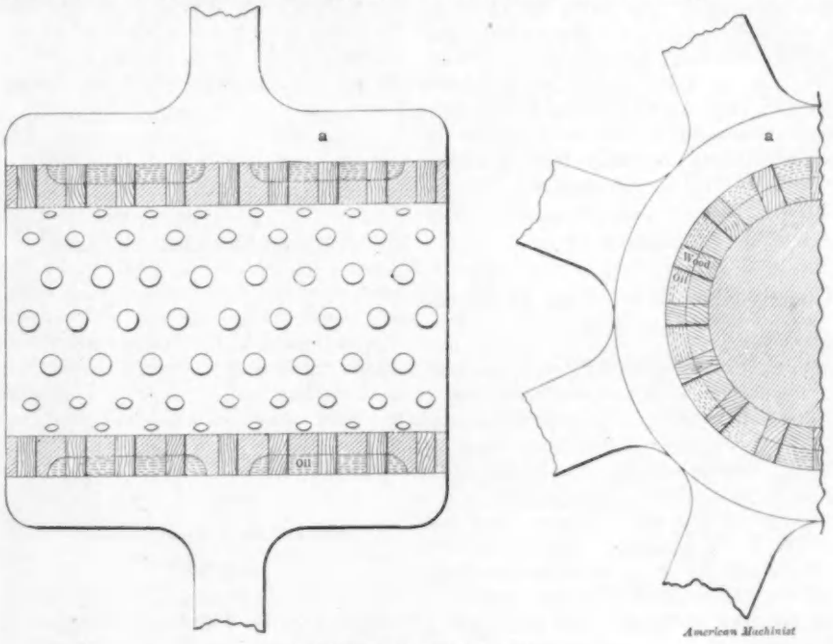
but one tool is working (as on an engine lathe), admit of some time for cleaning on most work while the machine is working. But on others, as a four-head planer working on locomotive cylinders, or work of a like nature, absolutely no time can be taken from watching the work being done; and, in fact, on most machines, and on most work, the workman is filling his full duty if he is watching the operation of his machine, to see that it is working exactly right. The machinist is therefore not "at fault."

ANOTHER SUPERINTENDENT.

Something About Loose Pulley Bushings.

Editor American Machinist:

Like everything else, the pattern shop has its troubles. Mine has been with a loose pulley on a counter-shaft that drives a buzz planer. Everything was tried in the line of oil cups, metal bushings, but



A LOOSE PULLEY BUSHING.

of no use; in a short time it would grind the same as before.

One day the superintendent came along and heard the beautiful tunes we were getting from the pulley and said he would fix that. So it was taken down, and the machine shop had one more repair job on its hands. In a short time it was put up in its place, oiled and set going. This was nearly two years ago, and to-day we do not have any trouble with it, and it is oiled only once a week. By the permission of the superintendent I will illustrate and describe the way he fixed it.

Fig. 1 is the hub with a straight hole through it. Fig. 2 is a cast-iron bushing turned and driven into hole in hub, with a lot of ⅜-inch holes drilled in it, as shown. The bushing, as you notice, is chambered on the outside, and is kept filled with oil by means of a small hole in hub. In these ⅜-inch holes, there are very porous hardwood dowels driven in, as shown in Fig. 3, which absorb the oil and keep the shaft moist all the time.

If any of the readers of the "American Machinist" have trouble like this, I would advise them to try this, as I know it is a grand shop kink. G. H. WILLARD.

Worcester, Mass.

The Oil Swindlers Still Busy—Another Generation of Fink.

Editor American Machinist:

Those Cleveland oil swindlers who have been exposed so often in your paper seem to be extending their business in the South. The company I work for have had several bargains offered them lately, of oil that has arrived here too late to fill an order, and which, therefore, will be sold at a great reduction rather than pay return freight.

The other day the manager came over to the engine room with a stranger and introduced him to me as a representative of Fink & Son, of Baltimore, having a great invention for sale for saving and improving all kinds of oils. The claims made for the mixture were about as follows: Cost of material, ten cents a gallon; one gallon of it mixed with one gallon of oil will make a better lubricant and reach further than two gallons of oil. High-grade oil is not needed, as this stuff makes every oil as good as the best. Cylinder oil treated this way will never show up in the ice of a refrigerating plant or give it a bad taste. To prove all this the agent had testimonials by the thousand from parties who had bought the right to use this mixture in factories of all sorts. Prominent among them were breweries, ice plants, packing houses and dairies. The plant that furnishes the ice for the White House in Washington uses the mixture too, and none can afford to be without it. I made no deal with the party, for if Fink & Son have such a process to improve and double every gallon of oil at a cost of ten cents they don't need to go far to get a nice big pile of cash for the invention. For separating cylinder oil from exhaust steam there are mechanical appliances, and they do it to perfection. Among one of the latest on Fink & Son's list of customers is a firm that I know well; quite smart people. They have an engineer also, but if it comes to deciding about adopting such important inventions as this of Fink & Son that matter is settled in the office, while the engineer is hunting in the scrap pile for an elbow to save the company the dime that a new one would cost. FRED KAISER.

Savannah, Ga.

[Our readers will recognize in Fink & Son an old acquaintance, to whom we paid our respects many years ago. It used to be plain John Fink, so that Fink & Son is an enlargement of the concern and an extension into the next generation, and we may expect the firm to continue in business for a long time yet—but not with the readers of the "American Machinist."—Ed.]

Incomplete Post-Office Addresses.

Editor American Machinist:

In letters from foreign countries frequently the name of the town only is given, without any further address, making it difficult to reply without, in many cases, investigating where the town is situated. This practice is also followed in the United States. Frequently the town only is given without the State.

We write this thinking you could take it up in your paper to advantage to all that are interested.

Manufacturers and dealers may think that they live in a town of so much importance that it is only necessary to mention the town, but there is no town so large but that a great many people never heard of it. THE ADAMS COMPANY.

Dubuque, Ia.

[Our correspondent's grievance is a real one, as we can testify from much exasperating experience. English people are the worst foreign sinners in this respect, while at home we find the practice most prevalent in Massachusetts. It will surprise most Americans to be told that in the United States there are four Chicagos, five New Yorks, seven Cincinnatis, nine Philadelphias, sixteen Bostons, twenty-one Brooklyns, and twenty-six Clevelands. —Ed.]

A Defence of the Engine Lathe.

Editor American Machinist:

Having read with much interest the criticisms of shop tools in general, and engine lathes in particular, it seems to me that some of the kickers are as much

at fault as the machines mentioned. I formerly entertained a similar idea about the wear in the upper part of the bearings due to the belt pull, the location of back gears and the thrust due to the cut of the tool. Actual tests, however, of different lathes and screw machines which had seen years of constant service, showed such excellent results as to force the conviction that the present arrangement is as nearly perfect as can be. I refer to the construction with the back gears located back of the spindle and means for taking up the wear in the spindle by closing down the caps.

While it is true that, for most cases, the wear on the front box is on the cap, due to the cut of the tool, the thrust of the back gears, and the belt pull (when it is on the front step of the cone), but we don't let our lathe run with enough play in this box to allow the spindle to jump up and down; but as soon as there is any noticeable wear, the cap is screwed down and the axis of the spindle is brought to its original position. Moreover, if the journal itself is worn to any extent, this adjustment will even bring it lower than it originally was. Sometimes, also, we have comparatively heavy jobs in the chuck or on the face plate when we use an open belt, and that on one of the smaller steps, which will help to wear the lower box, so we must admit that the wear on the front box tends to lower the axis of the spindle at that point. The same conditions exist in the rear box, with the exception that we can disregard the weight of the work and replace it with the thrust of the back gears, which in this box is downward. So the tendency is, to keep the axis of spindle in line with the lathe shears, with a minimum of wear on the lower boxes.

Now, suppose the back gears were under the spindle (and some of them are), it is easy to see that the thrust of the gears will cause the front box to wear on the back, and the back box on the front of the bearings, and I should think that a very slight wear in this case would be fatal to satisfactory results.

Suppose you have a lathe with that same old tail-stock with the swinging clamp, same old cone lock which requires a wrench to loosen it, nuts on the change gears, etc., which require half a dozen different wrenches or as many adjustments of the monkey wrench to make a change, your belt will run off every time you get too close to the end step; and last, that cross-feed screw turns the wrong way. When you get a slack day, or even if you never do, go to the boss (preferably after dinner) and call him over to your machine and tell him what you want to do. You are a reader of this paper and know, presumably, he is also, and also knows what ought to be done; and it won't take long before you have permission to make the necessary changes. It is an easy matter to put a couple of 3/8-inch pins on eacn side of that tail-stock clamp; give it anywhere near 1-16 inch play between the pins. In regard to the cone lock, shape a slot in the screw and make a wing, and press and solder or pin it in place. If possible, make the nuts all one size or put wings on them by putting a short pin on opposite sides. A handle should also be permanently attached to the screw which clamps the swinging arm for the intermediate gear, and the wrench can generally be dispensed with altogether. If no better plan suggests itself, it is certainly better to nail a couple of cleats next the cone to keep the belt from running off, than to repeatedly put it on. The cross-feed screw and nut are probably worn out and need replacing by new parts, and the new ones should be cut left-handed, and not the same as the old one, as I once saw done by a foreman who averred that "the makers of the lathe knew what was right."

When a good thing is observed on a new machine, it can often be added to some old machine at trifling cost, when the convenience attained is considered. For instance, equipping an old drill-press with the belt-shifter operated by the foot, and graduating the sleeve in inches by eighths, so as to readily read the depth which the drill has penetrated.

G. J. M.

Milwaukee, Wis.

Cherry Red, Blood Red, or Standard Red.

Editor American Machinist:

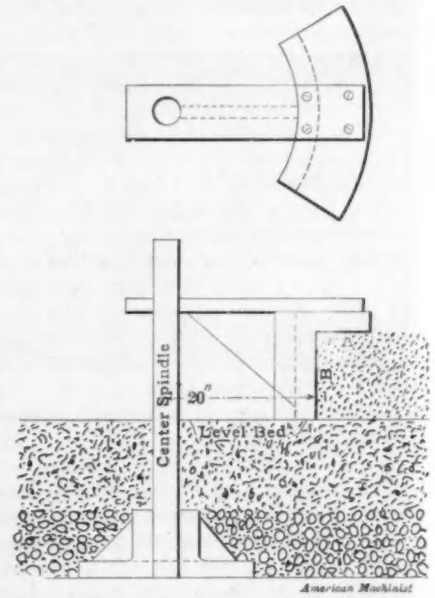
The writer is not a machinist, nor a blacksmith; but he has tinkered around factories for some years, say, thirty or forty. During all this time he has heard people talk about "cherry red" as a measure of heat for tool steel. And now comes F. W. Clough advocating the term "blood red" as being the preferable designation, because of the greater uniformity in the color of blood. Very well taken is his point that the color of the cherry varies from white to black, and that, therefore, the term cherry red has not the same meaning to all minds. How it can have any definite meaning to any mind in reference to heat measure it is difficult to see, for, being itself indefinite, it cannot measure anything else with any approach to accuracy. The term may be modified, as light cherry, or dark cherry; but there are white cherries, yellow cherries, pink cherries, light cherries, cherries, dark cherries, deep red cherries and black cherries. Now, except as to the first and the last named, not a reader of the above will have the same impression concerning the intermediate shades that the writer has, probably. If blood red is the color desired, it is, no doubt, the preferable term, as its color does not vary greatly, perhaps. But why blood red? Isn't it a sort of thumb rule, after all? What is the objection to establishing by elaborate experiment just the shade, or shades, of color required for various brands of steel, and reproducing them on slips of paper and supplying them in abundance to all users of steel? It is certainly to the interest of steel makers to instruct so far as possible their customers in the proper use of the product. These colors could be produced on slips of paper by the million at very little cost, and the whole world of steel users might then have uniform standards of color; and these colors could be at all times convenient to view; the blacksmith would neither have to go cherry picking nor blood letting in order to be able to standardize his hardening color.

E. H.

Molding the 40-Inch Piston.

Editor American Machinist:

In your issue of April 6 Mr. Bickle tries to explain how to make a cheaper piston. Now, in the first place, the articles about making a cheaper piston were not to make a new pattern, but to change an old pattern, reducing the casting in diameter



SWEEP AND BED FOR MOLDING A PISTON.

and thickness. In writing about changing it as I did the supposition was that there were core prints on the cope side of the pattern (which side would be the proper side to put them) to core out the inside of the piston and carry off the vent. Then Mr. Bickle speaks about ramming up a cope on a level bed; but as I said before, there are core prints on the cope side, and to locate them would be a difficult matter, and to locate them properly he would have to go to considerable trouble to get good results.

His method of sweeping up a piston of this description is much more expensive than using a pattern, for the molder would have to have a hole deep enough to allow for a coke bed to carry off the vent

from the bottom metal, to prevent blow holes in the casting. See sketch. A molder could ram up a drag and be ready for the cope by the time he could get his coke bed ready and have swept a level bed, not saying anything of sweeping up the piston. I do not see how he would use a sweep of his description, unless he should brick up the outside of the piston and sweep up in loam, to which expense I hardly think anyone would go. If he intends to dig a hole and bank up sand on the outside of the piston, and swing a sweep on a spindle to get the periphery of the piston and surface for the joint I cannot see how he will work it to get a solid casting, for he will not have any surface to ram sand against.

If he made a sweep as in the sketch he would have a surface to ram sand against, as at *A* and *B*, but would still have to contend with the difficulty of locating prints in a cope to locate the cores that core out the piston. His main object seems to be to get rid of a drag, as he says it would not be necessary to use one. No, it would not be necessary, but it would be far cheaper to use a drag than to dig a hole, ram a coke bed, sweep a level bed and sweep the piston, and ram up a cope on a level bed, and try to locate prints in their proper place.

If Mr. Bickle wanted to make a piston and did not want to use the old pattern, I think the cheapest way would be to make a new pattern, and mold in drag and cope, but for the purpose that this 48-inch pattern was used for (a one-casting breakdown job) I think the best and cheapest way was the one in your issue of March 16.

LOUIS BADEN.

The Iron Foundry Situation in Providence.

A Providence friend writes to us that the molders' strike which starts practically on the first of May may not, under the generally favorable condition of the machine business, be long lived, concessions being confidently expected. The molders demanded a minimum rate of $2.75 per day, abolition of piece work, and the recognition of the International Iron Molders' Union. The last item was waived to bring greater stress upon the wage question, but, with the exception of four firms who have an understanding with the molders, the request w 1efused. The firms mentioned, who will continue, are the New England Butt Company, Brown & Sharpe Manufacturing Company, Corliss Engine Works, and Rhode Island Locomotive Works. Of these, the Brown & Sharpe employ some seventy men; the Corliss works, which are on short time, have had eight only during past week, and the locomotive works will, after a long period of idleness, start up the foundry early in May. The strike affects some five hundred molders in Rhode Island, and if protracted will, of course, interfere with several thousand iron workers.

A Fast Train Run.

We have received the following schedule of a remarkable run made by the Chicago, Burlington & Quincy fast mail train, No. 15, on the night of April 23:

No. 15, APRIL 23 1899. CLASS "H," ENGINE 1512, ENGINEER KELLEY.

Distance from U. Depot	Distance between Stations	Time in Minutes		DELAYS
			Left U. D., Chicago, 9:58 P. M.	20 min. late, account waiting for Lake Shore mail.
8.5	8.5	15	Passed Clyde.....10:13 P. M.	Ran slow, acct. track elevation work.
37.4	28.9	25	Passed Aurora.....10:38 P. M.	
82.8	45.4	38	Arrived Mendota....11:16 P. M.	4 mins. taking water and mail.
			Left Mendota.....11:20 P. M.	
162.5	79.7	74	Arrived Galesburg...12:34 A. M.	4 mins. taking water and mail.
			Left Galesburg.....12:38 A. M.	
205.8	43.3	39	Arrived Burlington.. 1:17 A. M.	
	205.8	191		8

RECAPITULATION.

Distance from Chicago (Union Depot) to Burlington.....	205.8	m'l's
Running time, including stops.	199	min.
" " excluding stops.	191	"
Distance from Clyde to Burlington....	197.3	m'l's
Running time, including stops.	184	min.
" " excluding stops.	176	"

	Miles	Average Mls. Per Hour
Chicago to Burlington..	205.8	62.05
Clyde to Burlington....	197.3	64.33
Aurora to Burlington...	168.4	63.55

Personal.

Mr. Frank A. Crowell has accepted the position of superintendent of the Kendall Rubber Tire Company, of Providence, R. I.

It is announced that John Illingworth has disposed of his interests in the Benjamin Atha & Illingworth Steel Company, of Harrison (Newark), N. J., and will retire from business.

Harry B. Clark has resigned his position with Mossberg & Granville Manufacturing Company to accept one with the International Air & Power Company, and in leaving was presented with a handsome watch and chain by his fellow employees.

Mr. Arthur Manning Waitt, general master car builder of the Lake Shore & Michigan Southern Railroad, is to succeed Mr. William Buchanan as superintendent of motive power of the New York Central. Mr. Waitt is in his forty-first year and began railroading at twenty-one. He is a graduate of the Massachusetts Institute of Technology.

Mr. Richard Melhuish, who is head of the firm of Richard Melhuish, Sons & Co., machinery and hardware merchants, of 84 Fetter Lane, London, will visit this country soon, with the object of extending his acquaintance with American machinery-building establishments, and his address while here will be in care of Macdonal Company, 23 South William street, New York.

Obituary.

Anthony Tarbox, chief draftsman of the Household Sewing Machine Company, Providence, R. I., died in that city April 28; thirty-three years old. Mr. Tarbox had been in the employ of the company since his fourteenth year, and was a graduate of the Rhode Island School of Design.

William F. Noyes, master mechanic at the Portsmouth, N. H., Navy Yard, died in that city April 24. In his younger days he had charge of several large enterprises for the government. He superintended the construction of a dry dock at the Norfolk Navy Yard. His greatest work was the floating and saving of the old ship Monongahela, which was cast ashore on the coast of Mexico by a big tidal wave. She was left high and dry a mile inland. The work was done in the fierce heat of a tropical summer, and Mr. Noyes maintained the health of his men and got the ship safely into the water again.

In our issue of March 23 last, we noticed the death of a colored man in Providence, R. I., who, according to the "Providence Journal," had invented some features of the hair clipper made by the Brown & Sharpe Manufacturing Company. This statement seems to have been incorrect, however, as we learn that although Cook took out a patent on hair clippers, none of the features of his patent have been or are used by the Brown & Sharpe Company.

Commercial Conservatism.

"Commercial conservatism of a very queer sort has recently been shown by two coke syndicates, one in Belgium and the other in Germany. Both of them have notified their customers that no contracts for future delivery will be considered that call for larger quantities of coke than are specified in the contracts now running. Should any surplus remain after the regular deliveries are made, it will be distributed, the notices add, *pro rata* among the applicants. In other words, these syndicates seem to have been not delighted but annoyed by a demand for coke that exceeded their present facilities for production. Instead of making instant preparation for increasing their plants in proportion to or in advance of the growing demand, as would have been the first thought and speedy act of American producers, these slow-going persons have ordered their customers to keep both their ambitions and their business within established limits! Against competitors like these the manufacturers of the United States will be quite sure to carry the day, and it is no wonder that our bridges and locomotives are going abroad by the shipload."—"New York Times."

Although the action of these coke syndicates seems queer there is something to be said in its favor, nevertheless, and if a little more of the same kind of conservatism were to be found among manufacturers here we would hear of fewer disasters resulting from "trying to do a million dollar business on a thousand dollar capital," and there would not be so much of what is called over-production in dull times.

A report in a local paper of a test of the water supplied by the Angelica, N. Y., water works, and which report shows this water to be remarkably pure, is made the occasion of a communication from F. H. Jackson, town clerk of Angelica, who has been a reader of the "American Machinist" since its inception, and who describes his town as being one exceptionally well suited for the location of manufacturing enterprises and a pleasant and healthful place of residence for those connected with such establishments. Those who may wish full information regarding the matter may obtain it by addressing Mr. Jackson as above.

Discussion of the metric system continues to rage hotly in England, and it is evident that the threat of a compulsory change from the old units of weight, distance, capacity and value has developed an opposition of almost theological fierceness. The foes of innovation are not

(*Continued on page 39.*)

A HARDWARE SPECIALTY MANUFACTURING Concern wants to employ a man who can introduce a thorough, modern cost-keeping system. Address

Box 270, AMERICAN MACHINIST.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Shafting straighteners; best made; prices reduced. J. H. Wells, Tampa, Fla.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," price $1, post paid. J.L.Lucas,Prov.,R.I. Send for index sheet.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

Best workmanship; reasonable charges; watch, clock and other light machinery; send for samples of punch and die work. Waltham Machine Works, Waltham, Mass.

We want the contract to build light machinery, tools or models; first-class work guaranteed; shop 25 miles out of New York City. Box 284, AMERICAN MACHINIST.

Threads and gears; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. in postage stamps by G. W. Dixon, Spring Lake, Mich.

Institutions retiring from business having machine tools, brass or wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisement under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Mechanical draftsman wants position. Box 281, AMERICAN MACHINIST.

Situation wanted by first-class pattern maker. Address Box 285, AMER. MACHINIST.

An experienced foreman on engines and general machine-shop work desires position. Box 266, AMERICAN MACHINIST.

In drafting room or field work, as supt. of construction; mill work; 12 years' experience. Box 279, AMERICAN MACHINIST.

Foreman pattern maker wishes a change; middle age, and good experience; references if necessary. Box 286, AMER. MACHINIST.

Wanted—Position as foreman of machine shop; 14 years' experience as foreman; best of references. Address Box 277, AM. MACH.

As foreman on brass work; thorough, practical experience and good executive ability. Address Alfred, 80 Messer st., Providence, R. I.

Mechanical draftsman, experienced in shop and drawing room, able to design and work out ideas, desires to change. Address Box 280, AMERICAN MACHINIST.

Technical mechanical draftsman, 5 years' experience; new manufacturing plants a specialty; capable of taking charge of drawing room. Box 282, AMERICAN MACHINIST.

A man with extensive experience at designing machinery and tools for manufacturing purposes, wants position with a reliable concern. Box 276, AMERICAN MACHINIST.

A thoroughly competent designer and draftsman, with several years' experience in machine shop and drawing room on light and heavy machinery, desires to make a change. Address Box 272, AMER. MACHINIST.

First-class machinist, with 19 years' experience in rolling mill, sugar and general machine work, wants to change his position; was assistant foreman and erector in Germany, Cuba and United States. Box 274, AMERICAN MACHINIST.

A position as master mechanic or supt. of factory or plant, by a young mechanical engineer, age 34; a thorough mechanic; long experience in handling large numbers of men; reference the best. W. H. Arthur, 5 First st., Stamford, Conn.

An experienced mechanical engineer on general machinery, shop buildings, electric power and light distribution, boiler and engine installations; handy with transit; can take a responsible position; wishes situation at once. Address Box 273, AMER. MACH.

Help Wanted.

Wanted—An expert for estimating and laying out gear work. Address "Gear," A. MACH.

Mechanical draftsman, familiar with designing light machinery; rapid and accurate worker. Address Box 278, AMER. MACH.

Wanted—A mechanical draftsman being familiar with the best heavy machine-tool practice; must be rapid and accurate. Address H. G. M., care AMERICAN MACHINIST.

Wanted—First-class foreman for shop building heavy general machinery; one familiar with piece work; state experience. Address Box 250, AMERICAN MACHINIST.

Wanted—By a large New England firm, experienced draftsman, familiar with machine-tool designing. Address Box 287, AMERICAN MACHINIST, giving references, experience and wages wanted.

Wanted — One machine-tool draftsman, preferably with experience on grinding machinery; location, New England; state experience and salary expected. Address Box 275, AMERICAN MACHINIST.

Wanted—First-class machine and floor hands, by machine and engine works, Central Pennsylvania; steady employment, good wages and cheap living; state previous experience. Address Box 257, AMER. MACH.

Machinists wanted by engine builder located in the neighborhood of New York; skilled men only, to work on all-night gang; write concerning ability and pay expected. Address Box 230, AMERICAN MACHINIST.

Wanted—Foundry foreman to take charge of grey iron foundry in Chicago district, making light bench and floor work; one acquainted with the making of soil pipe and soil fittings preferred. Box 283, AM. MACH.

Wanted—Five or six good machinists and one blacksmith, to increase our force in machine shop building hoisting and haulage engines for coal mines. In applying give full particulars as to experience and age to Kenney & Co., Scottdale, Pa.

Wanted—A first-class draftsman, experienced in machine-tool designing; for the right man there will be prospect as assistant chief draftsman. Address Box 288, AMERICAN MACHINIST, giving references, experience and salary wanted.

Wanted—A first-class head draftsman who has had thorough technical education and shop experience; our work is mainly Corliss engine work, but prefer man with ice-machine experience; position open now; state experience; give references. Address Box 267, AMERICAN MACHINIST.

Wanted—A young or middle-aged man of good habits, familiar with modern methods of machine practice, to take charge of machine work in a shop devoted to building shapers, located in an Ohio town; state experience and salary expected. Address Box 271, AMERICAN MACHINIST.

Draftsman, hydraulic and mechanical, able to design and execute well-finished drawings, thoroughly posted in details of modern waterwheel construction and development of water powers; permanent position for a suitable man; give references and state salary. Address The Wm. Kennedy & Sons, Limited, Owen Sound, Canada.

TOOLS **A Large Asssortment of Regular and Special Tools for Machinists.**

If you want "The Best That's Made," write us.

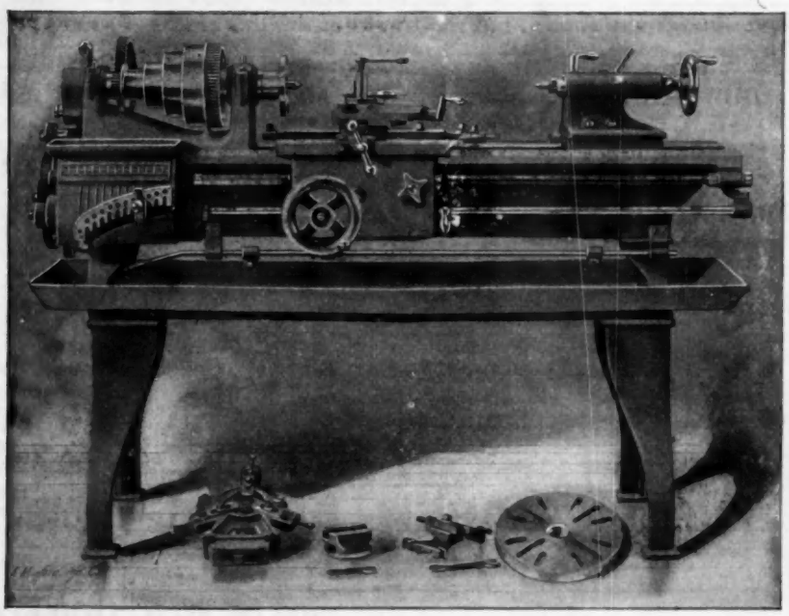
HAMMACHER, SCHLEMMER & CO., 209 BOWERY, NEW YORK.

The Hendey Machine Co.

TORRINGTON, CONN.

This Company is the sole owner of Letters Patents Nos. 468,183, 470,591, 519,294, 549,006 and 557,031, granted to P. & W. Schellenbach, W. P. Norton, and W. L. Schellenbach, for Improvements in Engine Lathes.

We take this method of notifying the public that we have already commenced suit against infringers of these patents, and that should it be found necessary to the protection of our rights, additional suits will be brought against manufacturers, vendors and users of infringing lathes.



The merits of these improvements have been widely recognized and have been wantonly copied. We shall take vigorous steps to protect our own.

The Hendey Machine Co.,

TORRINGTON, CONN.

UNITED STATES AGENTS:

Hill, Clarke & Co., Boston. Manning, Maxwell & Moore and The Garvin Machine Co., New York. J. W. Cregar, Philadelphia. U. Baird Machinery Co., Pittsburgh. The E. A. Kinsey Co., Cincinnati. Manning, Maxwell & Moore, Chicago. Pacific Tool & Supply Co., San Francisco.

EUROPEAN AGENTS:

Schuchardt & Schütte, Berlin, Vienna, Brussels, Stockholm. Chas. Churchill & Co., London and Birmingham, England. Adolphe Janssens, Paris, France.

(*Continued from page 38.*)

content with defending the "tables" with which they are familiar, but they attack the suggested "improvement" as false in principle and impracticable in operation. It must be admitted that many of the arguments presented are strong, even convincing. The conviction they bring, however, is not that a harmonizing of the world's measurements is unnecessary, but that the scientists of the different nations should get together and devise and agree upon a scheme more in consonance with human nature and human habits than is the achievement of the French theorists. Many of the British disputants evidence a consuming love for duodecimals, and though they do not go quite so far as to prophesy that the Arabic system of notation can easily and speedily be replaced, still they deny that reform is impossible, and grow enthusiastic in telling how enormous would be the resulting benefits. All this ignores the real basis of the demand for a change. Business knows no frontiers nowadays, and the products of every land go to every other in quantities greater or less. It is the multiplicity of standards, much more than the imperfection of any one standard, that causes inconvenience and expense. The merit of the metric system is the fact that it has already made its way into many countries, and therefore its adoption by them all would give the advantages of uniformity with comparatively little disturbance of established customs.—"New York Times."

Technical Publication.

"Proceedings of the Fourth Annual Convention of the National Association of Manufacturers." 106 8x10-inch pages. Published by the Association.

This pamphlet gives a complete stenographic report of the convention held at Cincinnati last January, a short report of which appeared in our columns at the time. To those doubting Thomases who still look upon this association as of little practical value, we recommend the reading of this report. There is no longer room for doubt as to the value of the work which the association is doing, that it deserves the support of all American manufacturers, and that it gives direct returns of many times the money value of the cost of membership.

The Grant Machine Tool Works, of Cleveland, O., has among other work in hand a large and heavy machine which they are building for the National Watch Company, of Elgin, Ill., and which is to grind the steel strips used for making watch mainsprings.

To detect cracks in steel tools, dip the latter in petroleum, rub the surfaces clean, and wipe over with chalk. The petroleum will, after a time, sweat out from the cracks on the chalk, and leave visible lines.

Inquiry for Machinery.

(102) Machines for cutting paper dress patterns.

Manufacturers.

The American Optical Company will soon build a four-story brick building, 200 feet long and 35 feet wide, adjoining their present factory.

The Goodyear Tire & Rubber Company, of Akron, Ohio, has increased its capital stock from $100,000 to $200,000. Additions are to be made to the plant.

James Clifford, Jr., announces that he will build a planing mill near Transit street, Buffalo, N. Y., and will begin work soon. The building will be 80x60 feet.

Plans for the rebuilding of the stove works at Quakertown, Pa., are being made by Architect Bean, of Lansdale. The new works will be a third larger than the plant that was burned.

The Ingersoll-Sergeant Drill Company, of Easton, Pa., has purchased five acres of land adjoining its present property, on which it is proposed to erect additions which will about double the present capacity of the plant.

The Wheeler & Wilson Sewing Machine Company, of Bridgeport, Conn., has affected the business of the Sewing Machine Cabinet Company to such an extent as to make it necessary to make additons to the latter plant.

Miller F. Moore & Co., shipbuilders, of Elizabethport, N. J., have purchased property at Harrison, N. J., upon which it is proposed to erect a new plant to cost $100,000, and it is expected that about 300 men will be employed.

The Berlin Iron Bridge Company, of East Berlin, Conn., has the contract for furnishing and erecting the structural steel work, consisting of beams, girders, roof trusses and other material, for the New Britain Institute, New Britain, Conn.

Braun & Fitts will build a four-story factory building at 196 and 197 North Union street, at a cost of $25,000. The plans are the work of C. J. Furst and provide for a structure with a frontage of 44 feet and a depth of 88 feet, and constructed of pressed brick and stone.

The Crescent Rental & Realty Company have sold to the Willard Manufacturing Company, of Boston, harness manufacturers, a lot of land containing 20,000 square feet, on Main and Lake streets, Winchester, Mass. The Willard Company are to build a factory on the property at once.

Isaac Hall, manufacturer of silk-mill machines and supplies, of Paterson, N. J., has purchased a site for the erection of a mill in Allentown, Pa., and will remove his plant to that place as soon as the building can be erected. The concern will give employment to 200 skilled mechanics.

The Lalance & Grosjean Manufacturing Company, Woodhaven, L. I., agate ware manufacturers, has filed plans for the erection of a three-story brick annex to its manufactory, 400 by 200 feet, to occupy the block bounded by Clinton and University places and Bigelow and Atlantic avenues, and to cost $80,000.

The firm of A. G. Spalding & Bros., is contemplating the erection of factory buildings in Harvey, Ill., costing $175,000 for the manufacture of bicycles and sporting goods. The H. A. Christy Company, manufacturers of bicycle saddles, and known to be one of

(*Continued on page 41.*)

The CROSS OIL FILTER

actually reduces oil bills 50% or more. Sent on approval. Capacities 3 to 150 gals. per day. Used in 23 countries. Testimonials from the leading firms in every field of industry.

THE BURT MFG. CO.
AKRON, OHIO, U.S.A.
Business Established 9 Years.
Largest Manufacturers of Oil Filters in the World.

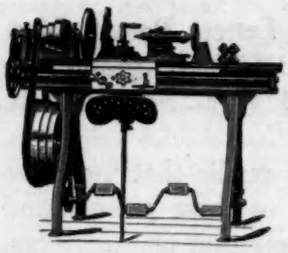
HANDICAPPED BY IGNORANCE

of the theory and principles of their profession, many ambitious men have been obliged to remain in subordinate and low salaried positions on account of the lack of technical knowledge. You can obtain a thorough technical education at home. Courses by mail in

Mechanical, Steam and Electrical Engineering,
Mechanical Drawing and Machine Design.
Best Text Books and Drawing Plates Free.

Seven years of experience in teaching by correspondence. Write for our illustrated Circular T, sample pages of text books, drawing plate and booklet of letters from students all over the world.

The United Correspondence Schools,
154, 156, 158 Fifth Ave., New York.



9 in. to 13 in. swing.

FOOT POWER LATHES

FOR THE
ELECTRICIAN,
EXPERIMENTER,
BICYCLE REPAIRING,
GENERAL MACHINE SHOP WORK.

Send for Catalog.

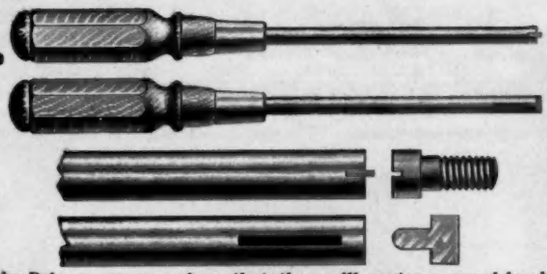
W. F. & JNO. BARNES CO., 1995 Ruby Street, **Rockford, Ill.**

CHAS. CHURCHILL & CO., English Agents, LONDON, E. C.

"I am so well pleased with my SAMSON SCREW DRIVER that I want two larger sizes."

This is an extract from one of the many letters showing what the mechanics think of this tool. Why should this be? Because it is the strongest Screw Driver made.

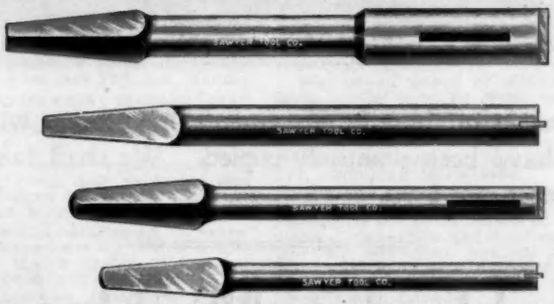
Because they save time, Save Screws, Save Labor, Save Screw Drivers.



Don't Mar Work, Split Screws, Turn Burrs, Cross Thread, Slip and Fly.

The end of the Drivers are cupped so that they will center a round headed screw and not slip.

SAMSON SCREW DRIVER BITS.



In testing these Bits we take any size flat headed wood screw whose slot is adapted to the bit used, place the point of the screw against the smooth surface of a rock maple plank, turn the screw into it until the head is flush, if the screw is strong enough to stand it. It is the strongest Driver that can be made, and it costs but a trifle to renew the blades. Three extra blades and a key come with each Bit or Screw Driver.

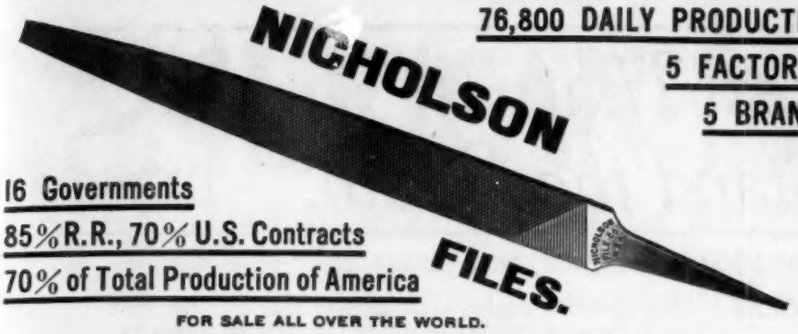
Handled by all Hardware Dealers who carry up-to-date Tools.

...SEND FOR NEW CATALOG...

MADE BY THE

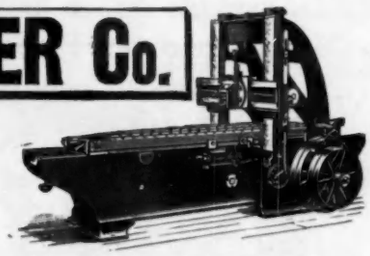
SAWYER TOOL COMPANY, FITCHBURG, MASS.

Manufacturers of Fine Tools.



76,800 DAILY PRODUCTION
5 FACTORIES
5 BRANDS
16 Governments
85% R.R., 70% U.S. Contracts
70% of Total Production of America
FOR SALE ALL OVER THE WORLD.
NICHOLSON FILE CO., Providence, R. I., U. S. A.

POWELL PLANER Co.
WORCESTER, MASS.



U. Baird Machinery Co., 125 Water St., Pittsburgh, Pa.
Robinson & Cary Co., St. Paul, Minn.
W. R. Colcord Mchy Co., 502 North 2d St., St. Louis, Mo.
Parke & Lacy Co., Fremont St., San Francisco, Cal.
The Fairbanks Co., 705 Arch St., Philadelphia, Pa.

We Claim the Following Merits for ..... Jenkins Bros.' Valves.

1. *Manufactured of the best Steam Metal.*
2. *No regrinding, therefore not constantly wearing out the Seat of the Valves.*
3. *Contains JENKINS DISC, which is suitable for all Pressures of Steam, Oil and Acids.*
4. *The Easiest Repaired, and all parts Interchangeable.*
5. *Every Valve Tested before leaving the factory.*
6. *ALL GENUINE stamped with Trade Mark.*

Jenkins Brothers, New York, Philadelphia, Chicago, Boston.

STEAM BOILER PRACTICE IN ITS RELATION TO FUELS AND THEIR COMBUSTION
AND THE ECONOMIC RESULTS OBTAINED WITH VARIOUS METHODS AND DEVICES.
By WALTER B. SNOW, S.B., Member American Society of Mechanical Engineers. First Edition. First thousand. x + 297 pages; 24 figures. 8vo. Cloth, $3.00. *Order through your bookseller; or copies will be forwarded, postpaid, by the publishers, on the receipt of the retail price.*
JOHN WILEY & SONS, 53 East 10th Street, New York City.

SUBSTITUTE FOR FERRO-SILICON.
Many of the largest steel manufacturers in the United States are using
CARBORUNDUM
or Carbide of Silicon in the place of ferro-silicon. They found that Carbide of Silicon was very high in Silicon—about 62 per cent. They found that it was easier to use because each package is marked with its exact proportion of silicon. They found it absolutely pure. You will find it so. We'll send you enough to make a test, free of charge. As an abrasive, Carborundum is the best substance known.
THE CARBORUNDUM CO., NIAGARA FALLS, N.Y.

CLEVELAND GEAR WORKS
W. R. SAWYER, Lessee.
86 Seneca Street,
CLEVELAND, OHIO.

Gear Wheels and Gear Cutting
Of all descriptions.
Get Our Prices.

BARGAINS IN NEW AND SECOND-HAND MACHINERY.
48 in. Bickford Boring and Turning Mill, 60 in. x 15 ft. Planer, 30 in. x 8 ft. Planer, 60 in. Boiler Makers' Drill, No. 2 Garvin Milling Machine, No. 3 Pratt & Whitney Screw Machine, No. 3 Windsor Screw Machine, No. 3 Bardons & Oliver Screw Machine. New Tools ready for delivery: 24 in. x 12 ft., 18 in. x 8 ft., 18 in. x 10 ft., and 15 in. x 6 ft. Lathes, and 16 in. Shapers.
Frank Toomey, 129-131 N. Third St., Philadelphia

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary.
L. B. BRAINERD, Treasurer.
L. F. MIDDLEBROOK, Assistant Secretary.

(*Continued from page* 40.)

the Spalding allied interests, has moved to Harvey and taken temporary headquarters with the Chicago Mining-Machine Company.

At Toronto, Ont., a new company has been organized which will take over the business of the Luxfer Prism Company and erect a factory for the manufacture of luxfer prisms. This factory will occupy a space of about 175x40 feet. Among the directors of the new organization are the following: Thos. W. Horn, president; William Mackenzie, E. B. Ostler, M. P.; Frederick Nicholls and H. C. Hammond.

The works of the Haydenville Company, at Haydenville, Mass., manufacturers of brass and iron valves, cocks, gages, lubricators and engine fittings, have been thoroughly reorganized, with the following officers: C. J. Hills, president; C. K. Sanborn, vice-president; A. S. Hills, treasurer. The company has also removed its New York offices from 73 Beekman street to the American Building, 150 Nassau street. This company is the successor of what was formerly known as the Haydenville Manufacturing Company.

New Catalogs.

We have received new catalog of screw and turret machinery built by Dreses, Mueller & Co., Cincinnati, Ohio. These machines are very clearly described, as are also the various attachments which accompany them. The catalog is standard size, 6x9 inches.

Globe Iron Works Company, Minneapolis, Minn., has issued catalog of the "White" gasoline engines, which are made for marine propulsion, pumping purposes, etc. A number of testimonial letters from users of these engines are included. The catalog is 6¼ x 9¼ inches.

The American Fire Engine Company, of Seneca Falls, N. Y., has issued a catalog illustrating and describing the Sheppard vertical automatic steam engine. The construction and method of operating of these engines are gone into, and the catalog is standard size, 6x9 inches.

B. F. Sturtevant Company, Boston, Mass., sends us circular describing electric propeller fans for ventilating laundries, boiler engine rooms, etc. These fans are made in all sizes from 18 to 120 inches, with capacities from 2,000 to 175,000 cubic feet per minute. The circular is 8x10½ inches.

We are in receipt from the Westinghouse Air-Brake Company, Pittsburgh, of bulletins Nos. 1, 2 and 3, No. 1 containing suggestions for the care of the Westinghouse air pump, No. 2 on the testing of air gages and reducing valves, and No. 3 on the location of main reservoirs on locomotives and their capacity. The bulletins are each standard size, 6x9 inches.

We have just received from the Rand Drill Company, New York, illustrated catalog of rock drills and drill mountings. A brief history of the growth and development of the rock drill is given. The catalog contains a number of illustrations showing the various types of these drills, and how arranged for drilling under varying conditions. The catalog is standard size, 6x9 inches.

From the Geo. F. Blake Manufacturing Company, New York, we have received a copy of their recently issued special 1899 catalog of air-compressing machinery. The various types of compressors are described minutely, a liberal spreading of both half-tones and line engravings supplementing the descriptive matter. The catalog contains some useful information to those interested in the installation and care of air-compressing plants. The catalog contains 102 pages, and is 6x7 inches.

"Presses That Stand the Strain."

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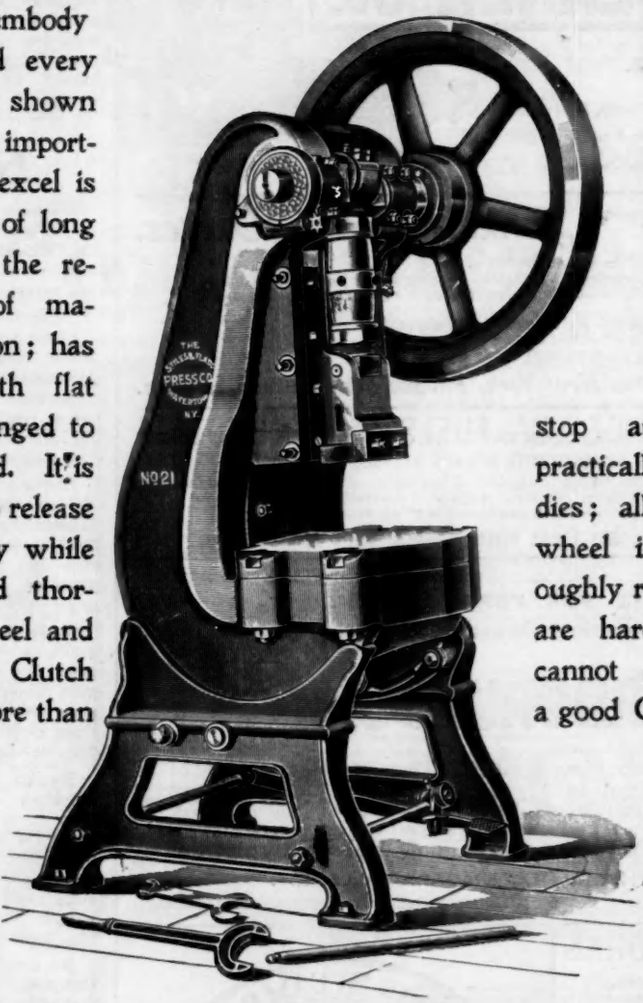

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